Outcomes in musculoskeletal injuries following road traffic crashes

An evaluation of an early intervention programme

Susannah Littleton

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An evaluation of an early intervention pilot program

Samantha Elliot

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A thesis submitted in partial fulfillment of the requirements for the degree of Bachelor of Education

The Australian National University
I, Susannah Littleton, hereby declare that this submission is my own work and that it contains no material previously published or written by another person except where acknowledged in the text. Nor does it contain material that has been accepted for the award of another degree or diploma in any university.

In addition, ethical approvals from the Australian National University, University of Sydney, Australian Capital Territory (ACT) Health, Canberra Hospital and ACT Health, Calvary Hospital Human Research Ethics Committees were granted for the studies presented in this thesis. Subjects were required to read a subject information document and informed consent was gained prior to data collection.

Signed: [Signature]

Date: 22/07/11

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As supervisor of Susannah Littleton’s doctoral work, I certify that I consider her thesis “Outcomes in musculoskeletal injuries following road traffic crashes” to be suitable for examination.

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Abstract

Introduction

This thesis evaluates the effect of an early intervention programme on the physical and psychological health status of people with mild to moderate musculoskeletal injuries following road traffic crashes, and examines the influence of accident fault status and compensation claim status on recovery.

Methods

A sequential cohort of patients presenting to emergency departments in the Australian Capital Territory for treatment of mild to moderate musculoskeletal injuries sustained in road traffic crashes were recruited.

A control group of 95 patients received the usual care provided. An intervention group of 98 patients were referred to a specialist clinic for assessment, during which an individualised, proactive rehabilitation plan was established.

Both physical and psychological health status were measured at baseline, six months and 12 months post-crash using the Short Form 36 (SF-36; Physical Component Score and Mental Component Score); the Hospital Anxiety and Depression Scale (HADS); and Functional Rating Index (FRI).

Three analyses were performed using the health outcome data obtained. Firstly, the influence of fault status on baseline physical and psychological health was evaluated by comparing the health outcomes scores of patients who caused the crash in which they
were involved with scores from patients who were not at fault. Secondly, the effect of claiming compensation was evaluated for the control group by comparing SF-36, HADS and FRI scores between patients of the control group who had claimed compensation and those who did not claim compensation. Finally, the effect of the early intervention programme was evaluated by comparing health outcome scores of the control and intervention groups.

Results

Patients were enrolled a mean of 9.3 days following the crash. In the immediate post-crash period, the cohort was characterised by severe disability (FRI 55.5, SD 21.04), moderate levels of pain (pain intensity sub-scale of the FRI 2.0, SD 0.81) and high levels of anxiety (HADS-a 9.1, SD 4.55).

Fault status had no effect on physical health; however, people that were not at fault had significantly worse psychological health at baseline as measured by SF-36 Mental Component Score.

Claiming compensation was associated with a worse SF-36 Physical Component Score, greater HADS-anxiety and worse FRI. Retention of a lawyer was significantly associated with a lower SF-36 Mental Component Score at 12 months.

The early intervention programme resulted in a statistically significant reduction in anxiety at 12 months. However, neither anxiety, nor any of the other measures of physical or psychological health were considered to be improved to a clinically significant level by the intervention.
Conclusion

Compensation status and psychological factors are independent determinants of longer term health following mild to moderate musculoskeletal injuries sustained in road traffic crashes. The early specialist assessment and proactive treatment planning implemented as part of this thesis, failed to improve health outcomes over usual care alone. Overall, recovery is influenced by both physical and psychological factors, and models of care need to address both of these components.
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Functional Rating Items

GHQ30 General Health Questionnaire

CAPT General or multiple

HADS Depression Anxiety

HADS-C Anxiety

HADS-D Depression

MONT Montgometry Count Test

VPT Visual Perception Test

AIRS Auditory Intake Rate

ABAAA Accelerated Back Activity Assessment
## Abbreviations

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<tr>
<td>ACE</td>
<td>Accident Care Evaluation</td>
</tr>
<tr>
<td>ACT</td>
<td>Australian Capital Territory</td>
</tr>
<tr>
<td>AF</td>
<td>At Fault</td>
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<tr>
<td>AIS</td>
<td>Abbreviated Injury Score</td>
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<tr>
<td>CES-D</td>
<td>Centre for Epidemiological Studies Depression Scale</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>CRF</td>
<td>Case report forms</td>
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<tr>
<td>CTP</td>
<td>Compulsory third party</td>
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<td>ED</td>
<td>Emergency Department</td>
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<tr>
<td>FRI</td>
<td>Functional Rating Index</td>
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<tr>
<td>GHQ</td>
<td>General Health Questionnaire</td>
</tr>
<tr>
<td>GP</td>
<td>General practitioner</td>
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<td>HADS</td>
<td>Hospital Anxiety and Depression Scale</td>
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<td>HADS anxiety</td>
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<td>HADS-d</td>
<td>HADS depression</td>
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<td>HREC</td>
<td>Human Research Ethics Committee</td>
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<td>IQR</td>
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<td>ISS</td>
<td>Injury Severity Score</td>
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<td>LOTE</td>
<td>Language other than English</td>
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<td>MAG</td>
<td>Management Advisory Group</td>
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<tr>
<td>MAIS</td>
<td>Maximum Abbreviated Injury Score</td>
</tr>
<tr>
<td>Abbreviation</td>
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<tr>
<td>MCS</td>
<td>Mental Component Score</td>
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<td>MRI</td>
<td>Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>MSK</td>
<td>Musculoskeletal</td>
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<tr>
<td>NAF</td>
<td>Not at fault</td>
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<tr>
<td>NDI</td>
<td>Neck Disability Index</td>
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<tr>
<td>NPAD-d</td>
<td>Neck Pain and Disability (German translation)</td>
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<tr>
<td>NSW</td>
<td>New South Wales</td>
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<tr>
<td>PCS</td>
<td>Physical Component Score</td>
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<tr>
<td>PSI</td>
<td>Primary Site of Injury</td>
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<tr>
<td>PTSD</td>
<td>Post-traumatic stress disorder</td>
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<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>ROM</td>
<td>Range of motion</td>
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<tr>
<td>RTC</td>
<td>Road traffic crash</td>
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<tr>
<td>SD</td>
<td>Standard deviation</td>
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<tr>
<td>SE</td>
<td>Standard error</td>
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<tr>
<td>SF-12</td>
<td>Short-Form Health Survey</td>
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<tr>
<td>SF-36</td>
<td>Medical Outcomes Study Short-Form 36 Health Survey</td>
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<tr>
<td>TAFE</td>
<td>Technical and Further Education</td>
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<td>TSK</td>
<td>Tampa Scale for Kinesiophobia</td>
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<td>VAS</td>
<td>Visual Analogue Scale</td>
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<tr>
<td>WAD</td>
<td>Whiplash Associated Disorder</td>
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Related peer-reviewed publications

Peer-reviewed papers


Peer-reviewed presentations

Littleton SM, Cameron ID, Poustie SJ, Hughes DC, Robinson BJ, Smith PN. Early access to specialist medical providers improves health outcomes for people with musculoskeletal injury following road traffic crash: a prospective controlled study. 70th Annual Scientific Meeting of the Australian Orthopaedic Association; October 14, 2010; Adelaide, Australia.

Littleton SM, Cameron ID, Poustie SJ, Robinson BJ, Hughes DC, Smith PN. The association of compensation on longer term health status for people with musculoskeletal injuries
following road traffic crashes: Emergency Department inception cohort study. 12th Meeting of the Combined Orthopaedic Associations; September 16, 2010; Glasgow, Scotland.

Littleton SM, Cameron ID, Hughes DC, Robinson BJ, Poustie SJ, Smith PN. Does fault status influence health in the immediate post-crash period following road traffic crashes?

Australian Orthopaedic Association (ACT) Annual Scientific Meeting; November, 2010; Canberra, Australia.

Littleton SM, Cameron ID, Poustie SJ, Robinson BJ, Hughes DC, Smith PN. Claiming compensation negatively influences longer term health status for people with soft tissue injuries following road traffic crashes: Emergency Department inception cohort study.

Australian Orthopaedic Association (ACT) Annual Scientific Meeting; November 27, 2009; Canberra, Australia.
Professional background

To elucidate on what brought the author to perform this research, the following professional background information is provided. I began my career as an intensive care nurse in public hospitals, first in Brisbane and later in Sydney. It was during this time that I recognised and developed skills in analytical thinking and pragmatism that I used in my nursing to improve the health related outcomes of the patients I worked with on a daily basis.

After a decade in nursing I moved into the area of sales, and then marketing in the field of medical devices. Over a period of twelve years I developed a greater understanding of the commercial imperatives that underpin successful business. Bringing a product to market requires a focus on demonstrating a competitive advantage; and more and more, industry relies on clinical research to demonstrate that advantage. Exposure to the clinical research performed in the medical devices industry led to an interest in clinical research.

In order to obtain a better understanding of the clinical research that underpins the marketing of new medical devices, I undertook a Master of Public Health at the University of Sydney in 2005. Whilst completing the Master of Public Health, I commenced some part-time work for a large general insurance organisation for whom I was initially engaged to analyse health outcomes in CTP and workers compensation claims. This introduced me to the field of insurance and compensation schemes.

As a result of my clinical background and understanding of the healing process and conventional treatment strategies in injury management, I was genuinely surprised at the
duration of illness/injury in the cases I was dealing with, and also at the costs associated with returning people to health. It appeared to take considerable time for people to recover from what seemed on the surface to be fairly minor injuries, and that prolonged recovery was achieved at an extraordinary financial cost. This was interesting from both a clinical and a commercial perspective, and ultimately led me to undertake this research in order to better understand the factors involved in people returning to good health after being involved in a traffic crash.

My involvement in this study was initially one of project management. From the project start-up, to development of the operational and governance models of the broader project, through to set-up and implementation of the assessment clinic intervention and development of the education programme. As I moved into the research programme I was involved in all aspects of patient recruitment, data collection and analysis, while still performing the role of ACE Study Project Manager.
Chapter 1. Introduction and Overview

1.1. Introduction

This thesis aims to understand how people recover from mild to moderate musculoskeletal (MSK) injuries sustained in a road traffic crash (RTC). It specifically evaluates an early intervention assessment and treatment coordination programme for people with minor injuries following RTCs. Additionally, it seeks to understand how seeking compensation for injuries influences health outcomes in a road crash setting. This research contributes to the understanding of recovery from minor soft tissue injuries and has the potential to improve health outcomes and reduce costs associated with such injuries caused by road crashes.

Recent systematic reviews conclude that recovery from MSK injuries is influenced by both physical and psychological factors (1-3). Furthermore, research evidence suggests that the quality of health outcomes for those injured within the context of a compensable environment, are poorer than for those who suffer similar injuries in a non-compensable environment (4)The factors influencing the quality of health outcomes are multiple and complex, and the poorer the health outcomes for the injured person the greater the associated health and compensable costs. One of the elements thought to influence recovery is the treatment available to injured people in the immediate period following the crash.
For some years, early assessment, treatment planning and structured rehabilitation have been used in the area of professional sport to aid recovery and rehabilitation. Financial imperatives have dictated the application of best practice in the treatment of soft tissue injuries in particular, within the elite sports environment (5). It has become accepted practice for elite level athletes to have their injuries treated via early intervention, expert assessment and the application of leading practice, evidence-based medicine. Once serious structural abnormality is excluded, short-term rest and the application of cryotherapy is generally followed by early mobilisation and rehabilitation (6). Such strategies are supported by clinical studies on the effect of early mobilisation on the pathophysiology of soft tissue repair (7, 8). The principles of early intervention, expert assessment, mobilisation and rehabilitation that are effectively applied in the elite sport setting could be equally well applied in all cases of soft tissue injury regardless of cause. This is particularly pertinent with respect to road crashes, where relatively minor soft tissue injuries continue to cause significant morbidity, disability, and societal and financial cost, often in the absence of identifiable structural abnormality.

This thesis evaluates an early intervention assessment and treatment coordination programme for people with mild to moderate MSK injuries sustained in RTCs. In considering the physical and psychological health needs of injured people, the research aims to modify clinical management in the early post-crash period such that subsequent health outcomes are improved. The findings will help inform policy and practice at a local health level in both hospital and general practice. In particular, the findings will point to how the specific needs of people who sustain minor injuries in RTCs may best be managed, considering both physical and psychological health impacts. In the
compensation setting, the research will contribute to policy development with respect to compensation scheme design. It will highlight the health benefits of early intervention for injured people and consider methods of improving access to healthcare in compensable environments. Finally, the research findings may help insurers develop a better understanding of how to improve value in claims administration, injury management and customer relationships. Internally, insurers may develop better working relationships with health service providers and ensure that their claims processes are fully integrated to support health delivery for injured claimants.

1.2. Setting

The Australian Capital Territory (ACT) of Australia is the geographical setting for this research which focuses on improving health outcomes for people injured in RTCs, within the context of an insurance scheme. Due to a well defined geographic area and a single provider of compulsory third party (CTP) motor vehicle crash insurance, this location represents an ideal research setting. The ACT has a population of 334,000 inhabitants, 188,000 of whom are employed (75 percent in full-time employment). Seventy percent of these employees travel to work by car (9).

The ACT health system is underpinned by the Australian tax-payer funded Medicare scheme which provides health services to all Australian citizens. In general, “public” patients (patients not utilising private health insurance) in public hospitals are not charged for medical services or fees associated with admission to hospital. There are, however, some exceptions to this, two of which are relevant to this thesis; firstly, people who are injured in a crash that was not their fault; and secondly, people injured during the course
of their work. In these cases, ACT medical services, including hospital Emergency
Department (ED) attendances, are invoiced directly to the injured person on the
assumption that a compensation claim will be lodged with the relevant authority.

The two public hospital EDs in the ACT are supported by strong community health
services. The ACT has approximately 400 registered general practitioners (204 full-time
equivalents) and there is access to high quality specialist and ancillary health professionals
(10). A higher than average proportion of the population is covered by private health
insurance (54 percent compared with the national average of 43 percent) (9).

The laws that govern motor accident compensation schemes in Australia are state-based,
with each jurisdiction having its own, unique CTP insurance scheme. However, there are
two main types of scheme: no-fault compensation schemes, such as in Victoria and
Tasmania; and fault-based common law schemes such as seen in Queensland and New
South Wales (NSW). The ACT, the setting for this study, has a fault-based compensation
system. At the time of this research, the relevant legislation was the Road Transport
(General) Act 1999 and the Road Transport (Third-Party Insurance) Regulations 2000. CTP
claims were also subject to the Civil Law (Wrongs) Act 2002 and the Limitation Act 1985.
The implication is that the ACT CTP scheme, at the time of the study, was fault-based,
minimally legislated and largely relied on common law. RTC victims who could prove the
crash was the fault of someone else were entitled to make a claim for both economic loss
(including compensation for past and future loss of earning capacity, and for past and
future medical treatment and care expenses); and non-economic loss or general damages
(including pain and suffering, loss of enjoyment of life and any loss of expectation of life
experienced as a result of the injuries). The insurer could, at its discretion, and on a 'without prejudice' basis make progressive payments for reasonably incurred medical costs. Otherwise payments for costs incurred throughout the claim were paid in a lump sum at settlement.

The ACT CTP scheme was privately underwritten by a single insurer at the time of this research. There were a total of 224,000 registered motor vehicles in the ACT (i.e. vehicles covered under the ACT CTP scheme) and 287,000 registered drivers. During the year prior to this research there were 7000 collisions reported to police, with 418 resulting in injury. The number of claims lodged with the CTP insurer was in excess of 800; 75 percent of these were for minor injury claims (Abbreviated Injury Score (AIS) (11) of 1). The total cost of these minor injury claims exceeded $40M (12). As the majority of CTP claims are paid as lump sums it is not possible to isolate the individual costs for economic loss (including medical treatments), non-economic loss (pain and suffering) and administration fees (legal fees, surveillance etc.).

1.3. Scope / Definitions

In this thesis the expression 'mild to moderate' is used to describe an injury which poses no direct threat to life. Although injuries are later described in terms of an Injury Severity Score (ISS), or Abbreviated Injury Score (AIS), the target group are people with non-life-threatening injuries. In the context of the RTC setting, these injuries are typically soft tissue injuries, although some people with non-complicated long bone fractures are also included.
Compensation is defined in plain English as “something given as reparation” or “the act of making amends for something”(13). A number of distinct avenues are available for compensation for injuries in this country depending on the context in which the injuries occur. Workplace injuries are covered under workers compensation; third party compensation is available for injuries sustained in motor vehicle crashes; public liability compensation is provided for injuries occurring on an owner/occupier premises or a place where the public frequents (e.g. slips and falls in public places); and victims of crime compensation is available to those suffering from injuries including psychological distress, that result from crime. In this thesis, compensation refers to the act of lodging a compensation claim under the compulsory third party insurance scheme for traffic crashes. That is, a process commenced which entitled an injured person to receipt of payment for various heads of damage. Whether the person actually received payments for any economic or non-economic loss during the course of this study is not considered in this thesis. In order to meet the definition of compensable, a personal injury compensation claim must have been lodged with the insurer.

1.4. Problem statement

RTCs are a significant cause of MSK injury in Australia (14). The most frequently reported injuries include Whiplash Associated Disorder (WAD), and injuries to the lower back, shoulder, hip and knee. Fifty percent of people sustaining such injuries experience poor recovery, and continue to report pain and disability two years following the crash (15). This creates a significant financial burden for the healthcare and insurance systems. Successful early rehabilitation has the potential to speed recovery and decrease the costs
associated with minor injuries. Effective post-crash management, treatment and rehabilitation strategies are therefore integral to reducing the economic burden of road crashes in Australia.

As the literature will demonstrate, factors influencing recovery from RTCs are multifactorial. A recent systematic review concluded that physical factors such as higher initial pain and disability, along with psychological factors such as passive coping, depressed mood and fear of movement, had prognostic value for limited recovery (1). Additionally there are other non-clinical factors that have been associated with limited recovery, such as involvement with the compensation system, and the structure and processes of the compensation system (1, 2).

Treatment for MSK injury following RTCs is aimed at decreasing pain and maintaining functioning in the early post-crash period. This includes the use of non-steroidal anti-inflammatory or other analgesic medication, physiotherapy, mobilisation and strengthening exercises. Patients are also often provided with some form of information and advice regarding what to expect in terms of pain and disability and how best to manage injuries. The current patient information emphasises a favourable prognosis and recommends that patients stay as active as possible, follow simple exercise regimens, accept the benign nature of their injuries and have a positive mental approach to their condition (16).

Despite the advice given to patients that emphasises a favourable outcome, the current literature suggests that recovery from minor injuries sustained in RTCs, and in particular WAD, may be poor and prolonged (1). Studies have shown that the long-term prognosis
can be predicted from patient data in the early post-injury stage. Of those patients who are asymptomatic at three months, 93 percent remain asymptomatic at two years. In contrast, patients who are symptomatic at three months are likely to show only minimal improvement after the first year (17). This suggests that successful early intervention might achieve a better long-term outcome for patients with MSK injuries due to RTCs, than where there is inadequate, inappropriate or no early intervention.

This thesis evaluates the Accident Care Evaluation (ACE) Study, a study initiated in the ACT to assess the effectiveness of early, active management of mild to moderate MSK injuries following RTCs. The aim of the ACE study is to determine whether early assessment by a MSK physician and management via a treatment plan, can improve the recovery of injured people. Treatment planning may include further radiological assessment, referral to a physiotherapist or other health professional, or initiation of a home exercise program. The intervention focuses on understanding the injuries, determining the expectations for pain and recovery, and providing patients with information about appropriate treatments.

1.5. Aims and hypotheses

This thesis aims to better understand how people recover from mild to moderate injuries sustained in RTCs. Secondly, it investigates the influence of a fault-based compensation scheme on health outcomes for these people.

The primary hypothesis for this thesis is that early access to healthcare providers for evidence-based assessment and treatment coordination will be associated with better
health for people with mild to moderate injuries following a RTC. Additionally, it is hypothesised that health status will be influenced by compensation.

Specific hypotheses:

1. The provision of an early assessment and treatment coordination programme will be associated with better physical and psychological health for people with mild to moderate MSK injuries sustained in RTCs.

2. The provision of an early assessment and treatment coordination programme will be associated with better physical and psychological health for people claiming compensation for mild to moderate MSK injuries sustained in RTCs.

For the purposes of the thesis, health will be defined and measured with the following tools:

1. Medical Outcomes Study Short-Form 36 Health Survey (SF-36)

2. Functional Rating Index (FRI)

3. Hospital Anxiety and Depression Scale (HADS)

1.6. Thesis overview

Chapter 2 will review the available literature pertaining to this topic. Following this, three analyses will be presented using data from a single cohort of participants recruited from EDs in the ACT following presentation for treatment of mild to moderate MSK injuries sustained in a RTC. The methods are described in Chapter 3. Chapter 4 describes the baseline health of people injured in RTCs and specifically investigates the influence of fault status on physical and psychological health following a crash. Chapter 5 describes the
long-term health of the control group of participants. It analyses this group based on compensation status and compares the physical and psychological health of participants who had lodged a compensation claim, compared to those who did not lodge a claim. The final analysis in Chapter 6, evaluates the early intervention treatment programme for people with minor injury following a crash. It compares the long-term health of participants undergoing standard care (control group) to participants who attended the early intervention treatment programme (intervention group). The three analyses will be discussed in the final chapter. The thesis finishes with conclusions and recommendations for healthcare service providers, policy makers, and key stakeholders in the insurance/compensation industry.
Chapter 2. Literature review

The cost of minor injuries caused by road traffic crashes (RTC) in Australia is conservatively estimated to be over $950 m per annum (14). Human costs such as rehabilitation, long-term care, decreased quality of life and workplace disruption account for over 55 percent of the total cost of RTCs (14). Successful early rehabilitation has the potential to speed recovery and decrease the costs associated with minor injuries. Effective post-crash treatment and rehabilitation strategies are therefore essential in minimising the economic burden of RTCs in Australia.

Although soft tissue injuries to the lower back, shoulder, hip and knee are reported, whiplash associated disorder (WAD) is by far the most frequently reported soft tissue injuries following RTCs (18). It is for this reason that most of the literature relating to musculoskeletal (MSK) injuries in RTCs focuses on WAD and neck pain.

This chapter reviews the literature pertaining to health outcomes and treatment strategies for people with MSK injuries. Predictors of recovery are reviewed first, followed by a review of current treatment strategies for people injured in crashes. The final section draws together the main conclusions from the literature pertaining to early intervention treatment strategies.
2.1. Predictors

The literature relevant to recovery from MSK injury following a crash will be reviewed under the broad groupings used throughout this thesis: demographic, crash-related, physical and injury, psychological and compensation factors.

2.1.1. Demographic factors

2.1.1.1. Age

There is some evidence from population studies across several nationalities, that increasing age translates to poorer patient outcome (19-21). Radanov and Sturzenegger (1996), using logistic regression identified increasing age as significantly contributing to poorer outcomes in a study investigating 117 Swiss patients (22). In the authors’ regression equation, increasing age was linearly related to outcome at one-year. Another study (23) used logistic regression to evaluate patients at six months using the Neck Disability Index (NDI). This study also found that age was a significant predictor (correlation coefficient 0.13) for having persistent moderate to severe symptoms. This model had a low false positive rate but a high false negative rate, only being able to correctly predict 37 percent of patients in the affected group. These studies clearly demonstrate a positive correlation between age and outcome, but the influence of age was not particularly strong, and other factors also contributed to the presence or absence of symptoms in these cohorts of patients.

A study evaluating children (4 to 16 years) (24) found that the clinical course of WAD was more favourable in this group compared with adults. Affected children were categorised
as having either mild or moderate symptoms (WAD grade 1 or 2). The moderate symptom group had a mean clinical course of 8.8 days with a maximum of 70 days.

A study of Australian patients (25) using either early or late compensation settlements as markers for injury resolution, found that age was not a significant predictor for settlement. They did, however, find that patients in the over 65 age strata had markedly shorter time to legal settlement. It is possible that the use of settlement time may be less useful for predicting the prognostic effect of advancing age. Indeed engagement of a lawyer was significantly associated with later outcomes, suggesting that objective health outcomes were not necessarily closely correlated with time of settlement. However, a Swedish study (26) evaluating a very large number of patients using regression analysis, also did not support a correlation between age and poorer outcomes. In fact, these authors found that the relative risk of injury for patients over 55 years of age was reduced compared to other age categories. Additional studies using these same data (27) with more sophisticated regression models, also failed to detect age as a prognostic factor. It is difficult to reconcile the results from the Swedish and Australian studies with that of the other population based studies mentioned earlier.

Hill et al. (2007) found that age was a negative prognostic factor for patients referred for treatment of neck pain (28). However, these patients had not necessarily been exposed to traffic crashes. Indeed Hill et al. found that demographic data in general had a greater prognostic potential than clinical data collected at the time of referral. Taking into consideration this study, as well as conflicting findings from data collected from people
injured RTCs, it is possible that the effect of age on recovery from neck pain is distinct from an effect associated with being involved in a RTC.

2.1.1.2. Gender

There is consistent evidence that female gender contributes to poorer outcomes. This has been established by population based studies (21). A study of 255 car occupants that had been involved in a crash was carried out to evaluate specifically the length of sick leave and the receipt of disability pensions rather than health outcomes. This study found that females were more than twice as likely as men to take sick leave, and three times as likely to take prolonged sick leave. Other population based studies failed to find gender differences (29-31). Bunketorp et al. (2002) in a cohort study of 121 patients, conclude that while females may more frequently report neck pain, and seek medical attention for neck pain following RTCs, there is no gender difference in the long run (29). A gender effect may therefore be dependent on the analysis methods and particularly, timing of data collection.

Mayou and Bryant (1996) made the observation with their data, that as well as female gender being a contributor to the prediction of a poorer outcome, there was also an interaction between gender, and driver-passenger status (32). Therefore, studies purporting a gender effect may overstate this effect if the authors have not controlled for driver-passenger status. The consequence of exposure to neck injury in females is supported by Bring et al. (1996) who also found that females were over represented as passengers, and in rear and side impact accidents, whereas males were more frequently drivers, and were over represented in head-on collisions and single vehicle crashes (33). A
further consideration was that small car occupants tended to have more neck injuries, and female drivers in this cohort more frequently drove smaller cars than males.

Another study by Bunketorp et al. (2005) compared a cohort of patients that had been exposed to motor traffic crashes (17 years previously) and a control group that had not (34). They found that there was no gender difference in the presence of neck pain in the crash group, whereas in the control group, there were a significantly greater number of females than males reporting neck pain. This again highlights the possibility that gender may have an effect on neck pain and long-term physical health outcomes independently from involvement in RTCs.

2.1.1.3. Culture

While neck pain and related injuries would seem to occur wherever there are vehicles and crashes, recovery rates appear to vary in different cultures. A landmark study in Lithuania demonstrated that although acute injury associated with neck pain following a crash occurs as it does in other countries, the progression to reporting of chronic symptoms does not (35). In this historical cohort study of 202 participants involved in a rear-end crash in the previous one to three years, none of the participants reported persistent or disabling symptoms that could be attributed to the crash. The authors suggested that the reason for non-progression to chronic injury was that culturally, Lithuania is a country in which there is little awareness or experience of whiplash injury causing chronic pain and disability. Additionally, the possibilities for secondary gain (financially or otherwise) are minimal. In a later prospective, controlled inception cohort study in the same country (36), 47 percent of 210 participants, identified from the daily register of traffic police, who
had been involved in a rear-end crash, reported initial neck pain. The median duration of pain was three days, maximal duration 17 days. After one year, there was no difference between the crash victims and the control group in terms of frequency and intensity of symptoms. It was determined that acute whiplash injury is a universal phenomenon but chronic whiplash is culturally-dependent. Additionally, the authors commented that spontaneous neck pain and headaches are frequent occurrences in the general population over a period of one year, and that in Western countries, these episodes may be incorrectly attributed to a previous RTC.

Similarly, Partheni et al. (2000) demonstrated that chronic whiplash is a rare event in Greece, when they studied 180 people involved in crashes who were recruited consecutively following presentation to the ED (37). Once again, participants reported initial neck pain, headache, shoulder pain, arm numbness or pain, and dizziness, but at four weeks post-crash 90 percent had recovered and all participants had returned to work.

Cultural differences may be expected to impact on outcomes in numerous ways, and this should be considered given the preponderance of traffic crash studies from Scandinavia as well as the UK, Australia and North America. Translation of the findings of these studies to a wider population should consider the role that culture plays in outcome.

2.1.1.4. Employment status

Some authors have found that the employment status of accident victims affects post-injury health and return to work outcomes. Self-employed workers have been found to spend less time off work, but to recover more slowly than employees (38). In this same
study, of the small number of people not returning to work (7%), employees that
undertake hard physical labour were over represented (38). However, in another study,
these employees were greater than four times more likely to have recovered at six
months (39), suggesting that heavy manual labour may be protective and is a good
prognostic indicator.

Suissa (2003) and Harder et al. (1998) both found that not being employed full-time was a
risk factor for prolonged recovery (20, 21). Suissa noted that the association was weak,
and considered it likely that employment status was linked to other social factors that may
have influenced the result (21). Hence employment status itself is unlikely to influence
recovery rates. Indeed Osti et al. (2005) evaluated the type of employment, including
category of job and full-time status, and found no effect on the speed of settlement of
claims (25).

2.1.2. Crash Related Factors

The literature disagrees with regard to the value of crash related factors as prognostic
indicators. Several authors have found no prognostic value for crash factors such as type
of crash; direction of impact (40, 41); speed/energy of impact (41-45); position in the
vehicle (25, 45); position of neck on impact (40); awareness of the crash (40); and level of
damage to the vehicle (25).

Atherton et al. (2006) evaluated a wide range of collision specific factors as well as
psychosocial factors on the persistence of neck pain (40). The authors established five
main criteria; presence of pre-collision widespread pain (yes or no); vehicle type (car or
not); number of WAD symptoms (0-4 or ≥ 5); neck disability index (0-18 or ≥ 19); psychological distress (General Health Questionnaire (GHQ) score 0-5 or ≥ 6). The presence of these five binary factors increased the risk of persistent neck pain from 14 percent to 80 percent.

Some literature that disagrees with the information above includes a study by Osti et al. (2005) in which it was found that the type of crash had a significant association with the speed of claims settlement, with head-on collisions having the longest settlements (25). This was supported by the study by Harder et al. (1998) that found greater persistence of whiplash injuries in people that have head-on collisions and strike fixed objects (20). Furthermore, Kaale et al. (2005) provides Magnetic Resonance Imaging (MRI) data to demonstrate that people with whiplash have a greater occurrence of soft tissue injuries than control patients, and in particular, the severity of lesions are greater for patients in head-on collisions and for patients with their heads to the side at the time of impact (46). These results are at odds with other literature claims that side and rear impact collisions are poor prognostic indicators for delayed recovery from neck injuries (21, 33). Changes to the classification of accidents, and in some cases, the small numbers of patients in the head-on-collision groups raises some concerns over the validity of these findings. In fact, when Osti et al. (2005) performed regression analysis on their data, the effect of the type of collision was excluded from the model due to collinearity with other factors (25).

Lankester et al. (2006) have found that the people occupying the front position in a car are more vulnerable to poorer outcomes following the development of whiplash (47).
Similarly, Harder et al. (1998) found that being a passenger was a poor prognostic factor for long-term whiplash injury (20).

Most studies evaluate factors that may affect prognosis of whiplash and neck disability following low energy trauma. However, some authors have looked at the association between whiplash and the severity of injury (43, 44, 48). These authors failed to find an association between injury severity and the incidence and prognosis of whiplash.

### 2.1.3. Physical Factors

The most commonly cited physical factors that provide prognostic information are the presence of pre-existing pain (30, 35, 40, 47, 49, 50) and the initial post-crash pain intensity (2, 3, 23, 27, 28, 30, 31, 41, 42, 51-60).

Atherton et al. (2006) whose data is comprised of survey responses, claims that by identifying patients with prior injury, greater severity of initial injury (initial neck disability) and certain psychological factors, a clinician can identify a subgroup with high likelihood of persistent symptoms (40). Similarly, Kivioja et al. (2008) found that prior neck pain and a high level of emotional distress were both associated with a ten-fold increase in the risk of persistent neck pain following a whiplash injury (50). In the Lithuanian study cited previously, the authors have found that post-crash chronic symptoms do not appear to be caused by the crash, but are rather a continuation of a pre-existing condition (35). The implication being that persistent injuries reported following a whiplash injury may be susceptible to an attribution error.
Some authors, however, have not been able to demonstrate an association between prior injury and persistent neck pain (19, 45, 61). These studies did find an association with the severity of initial injury. Presumably the method of data collection or the measurement of outcome may account for the discrepancy.

Dufton et al. (2006) observes an interesting interaction between lawyer involvement as well as employment status, and post-injury severity (53). The authors note that these non-physical factors had a greater effect at low injury severity. The complexity of the effect of physical factors is compounded by inconsistency in the literature. For example, Scholten-Peeters et al. (2003) and Williams et al. (2007) performed comprehensive literature reviews and found little evidence for patient demographics, psychosocial, crash related factors and pre-existing conditions as prognostic indicators (60, 62). In contrast they found that severity of injury did provide useful prognostic information for persistence of neck injury. This is to say that with the exception of initial pain intensity, considerable controversy remains regarding the utility of other factors as prognostic indicators for neck injury patients. Unfortunately, not all authors agree; Richter et al. (2004) concludes that psychological factors are more important than even baseline neck injuries (41). Not surprisingly Kamper et al. (2008) call for validated outcome measurements to improve consistency between studies (3). Baltov et al. (2008) make a distinction between measurable outcomes of pain and disability from other outcomes such as distress and return to work (51). These authors report that while psychosocial factors affect the latter, baseline physical injury including disability is the only factor associated with the former.
Due to the generally accepted reliability of post-crash pain as a prognostic indicator, some authors believe that health care providers should use a measurement of pain such as a visual analogue scale (VAS) or other simple ratings to identify patients at a high risk of persistent injury (54, 57). Kasch et al. (2008) took this approach, and divided consecutive whiplash patients into high or low risk based on pain intensity, number of non-painful complaints and neck mobility (55). They found that each of these factors increased the relative risk of disability at one-year approximately four-fold.

Rubinstein et al. (2008) evaluated patients that attended chiropractors with neck pain (63). The only consistent factor was the time since neck injury, with shorter duration injuries having a better prognosis. This study is consistent with the crash literature in that the intensity of pain is a valuable prognostic tool.

Sterling et al. (2003) identified a pattern of generalised hypersensitivity shortly after injury in patients with persistent moderate to severe symptoms at six months (64). This pattern was not evident in patients whose symptoms resolved. The interesting aspect of the study is that on the one hand it suggests an aetiology for the persistence of symptoms being a change in central pain processing mechanisms; on the other hand it suggests that the RTC is causal to the persistent injury. This is contrary to the proposal from the studies, previously cited, which were performed in a country with a naive appreciation of compensation and the linkage of whiplash with disability (35, 36). These studies suggest that the RTC is incidental.
2.1.4. Psychological Factors

2.1.4.1. Anxiety

Anxiety behaviours are similar to those of fear but are less intense and are usually associated with fear-avoidance behaviours and hypervigilance (28). There is a consensus that anxiety, particularly in the early period of the whiplash injury, is a negative prognostic factor (41, 47, 54, 65-67) and is associated with persistent pain and disability.

A study by Blozik et al. (2009) found that according to the HADS anxiety subscale, 28 percent of patients were reported to be anxious (65). This anxiety was significantly linked with higher levels of neck pain, even after adjusting for all baseline variables. Each point increase in the anxiety subscale resulted in an almost 1-point increase in the German translation of the Neck Pain and Disability (NPAD-d) score (95% CI 0.36–1.42). The authors reported that a person presenting all symptoms of anxiety according to the HADS anxiety subscale would have a 19-point higher NPAD-d score compared to somebody with no signs of anxiety. Atherton et al. (2006) also report that a high level of general psychological distress, as assessed by the GHQ, results approximately in a doubling of the risk of persistent neck pain (40). This is further supported by Kivioja et al. (2008) who found that a high degree of emotional distress at the time of the accident was associated with a tenfold increased risk of developing chronic neck pain (50).

Two studies by Sterling et al. (2003; 2005) report on the psychological predictors of outcome following whiplash injury (23, 68). At six months post-injury, patients were classified using scores on the NDI as being either recovered (score of 8 or less), as having
mild pain and disability (score of 10–28) or having moderate/severe pain and disability (score of 30 or more). All three groups demonstrated psychological distress to some extent at one month post-injury. In patients that recovered or had only mild persistent symptoms, distress levels returned to a level regarded as normal by two months post-injury. These patients also had a decrease in reported pain and disability. In patients with ongoing moderate/severe symptoms distress levels remained elevated (68). Elevated early distress levels have also been reported by Chien et al. (2008) (69) and Kongsted et al. (2008) (70). In the study by Kongsted et al. (2008) 13 percent of patients had a moderate to severe baseline stress response.

There may also be some relationship between gender and anxiety. Lankester et al. (2006) found that pre-accident anxiety level was associated with outcome, and females were more likely to have pre-accident anxiety complaints, suggesting that female patients are also more likely to have a poorer outcome (47).

Mayou et al. (2001) found that post-accident intrusive memories and perceptions were major predictors of symptoms and were related to evidence of initial emotional distress and to patients' beliefs about their physical outcome (71). Boersma et al. (2005) also found that distress and fear-avoidant beliefs are important factors in pain related disability in patients seeking primary care for acute or sub-acute spinal pain (72).

In addition to the relationship between anxiety in the early period following injury and neck pain disability, pre-accident anxiety also has a negative effect on outcome (19, 47).

There is a general consensus that elevated levels of anxiety are common in all patients with whiplash injury irrespective of injury severity. Anxiety quickly decreases in patients
who recover and in those with lesser symptoms of neck pain and disability. Improvement in anxiety levels also coincides with improvement in pain and disability levels. Patients with persistent moderate/severe neck pain and disability continue to be psychologically distressed, demonstrate acute post-traumatic stress symptoms and have a higher need for sick leave (72).

2.1.4.2. Depression

Depression is one of the major prognostic factors contributing to the development of chronic injury following a RTC. Compared to normal healthy subjects, patients with whiplash injuries demonstrate more depressive symptoms (73). Even patients with no prior history of mental illness demonstrate a high incidence of depressive symptoms. Carroll et al. (2006) found that of 5,211 subjects with no prior mental illness, 42.3 percent developed depressive symptoms within six weeks of whiplash injury. The depressive symptoms were recurrent or persistent in 37.6 percent of those with early post-injury onset. Delayed onset of depressive symptoms occurred in 17.8 percent of the patients. Pre-injury mental health problems increased the risk of delayed onset of depressive symptoms and of a recurrent or persistent course of early onset depressive symptoms (74). In patients with a history of psychiatric disease in which depression dominates, a poor outcome as a result of chronic symptoms of WAD is more likely (47, 75).

Persistent pain is one of the symptoms most frequently attributed to depression (28, 65, 73, 76) and a number of studies have shown that depression is an independent risk factor for chronic pain in patients both with and without pain at baseline (76). Patients who develop chronic pain are more likely to have had a prior history of depression than
patients who recover (75). Lee et al. (1993) found that patients who were most depressed had a more prolonged history of pain and gave the highest rating of pain according to the McGill Pain Questionnaire (73). This is supported by Carroll et al. (2006) (74). The level of depression has also been shown to correlate with pain score. For each point increase on the 60-point Centre for Epidemiological Studies Depression Scale (CES-D), the rate of onset of troublesome neck pain rose by four percent. Patients with depression (based on a cut-off score of CES-D 16) were almost twice as likely to develop troublesome pain. Those in the highest quartile of depression scores had almost four times the risk of pain onset as those in the lowest quartile (76). This is supported by Blozik et al. (2009) who found that after adjusting for all baseline variables, each point increase in depression as measured on the HADS depression subscale led to a 1.5-point increase in the NPAD-d score (65).

Unfortunately, none of these studies identify the mechanisms by which depressive symptoms result in chronic pain. It is clear, however, that a single, direct causal pathway between depression and pain is unlikely. Carroll et al. (2004) suggest that coping style may be one mechanism that relates depressive symptoms to chronic pain, particularly as passive coping has been consistently associated with both depression and severe pain (76).

In addition to the effect on chronic pain, depression has also been shown to delay return to work (77) and result in a slower time to claim closure, reflecting the poorer rate of recovery for patients with depressive symptoms (52).
2.1.4.3. Anger/Blame

Feelings of anger and blame are typical for people involved in RTCs, particularly if they are considered not at fault (NAF). People that are NAF in a RTC are often angry, resentful and feel highly inconvenienced by the actions of another party that has resulted in injury to themselves (78). Individuals that are classified as NAF typically have a slower recovery than those who are at fault (AF) (19), suggesting that feelings of anger and blame influence outcome.

The association between attribution of responsibility for an accident causing injury, and blame with post-traumatic stress disorder (PTSD) has been explored in a number of studies. From these it appears that blame is a predictor of PTSD, which in itself results in a more prolonged recovery. Having an unsettled claim, use of a lawyer and blame are all strongly associated with each other, and are all significant independent predictors of PTSD (79). In a study of 188 consecutive people injured in road crashes, with multiple injuries or whiplash neck injury, it was found that almost one-fifth of subjects suffered from an acute stress disorder during the early stages of injury. In most cases, this anxiety and depression had improved by 12 months; however, in one-tenth of patients PTSD remained evident. From this, the authors concluded that post-traumatic symptoms following RTCs are common and disabling (80).

Two studies have demonstrated a lower incidence of PTSD in patients who attribute blame for an accident to themselves (79, 81). Delahanty et al. (1997) found that 19 percent of patients who blamed themselves for the accident suffered PTSD, whereas 29 percent of those who blamed others were diagnosed as suffering PTSD (81). While it has
been shown that initially all accident victims experience the presence of intrusive thoughts that cause distressing reminders of the accident, only those that blamed another party for their injuries continued to demonstrate increased distress at six and 12 months (81). Those patients with PTSD who blame themselves are less symptomatic initially, recover more rapidly than those who blame another party for the accident and are more likely to have recovered in the short-term (81, 82). Interestingly, while the severity of post-traumatic stress symptoms are significantly different between people who blame another party for their injuries and those that attribute blame to themselves, the overall physical impairment / injury severity is not significantly different (82).

Ferrari and Russell (2001) have proposed a number of explanations for why feelings of blame are associated with poor recovery (83). Firstly, it has been suggested that drivers who blame another party for their injuries often have a larger audience that includes physicians and lawyers that act to remind the person of their injuries and affirm their own negative feelings about their injuries. The audience acts to maintain a focus on the person’s pain and injury which results in the person becoming more hyper-vigilant about their symptoms and also more inclined to amplify their symptoms, which leads to chronic pain behaviour (83).

2.1.4.4. **Catastrophising**

Catastrophising can be defined as an exaggerated negative response toward pain stimuli and pain experience (84, 85). It is strongly associated with poor psychological functioning among patients with pain of a shorter duration (86) and has a strong association with poor
long-term outcome (28). Pain catastrophising, where patients perceive pain as threatening, is also related to the severity of concurrent whiplash disability (87).

Several studies have demonstrated that catastrophising has a significant effect on disability and hence recovery from WAD. Nederhand et al. (2004) found that patients that were considered to be disabled according to the NDI, had a higher baseline score on the Tampa Scale for Kinesiophobia (TSK) catastrophising subscale than patients who were not considered disabled (53.2±24.4, compared with 28.6±22.2) (57). Soderlund and Lindberg (2003) also found that catastrophising was positively correlated with disability from as early as six weeks and was positively correlated with Pain Disability Index Score at six and 12 months (88). Sullivan et al. (1998) propose that the “rumination factor” (e.g. ‘I can’t stop thinking about how much it hurts’) is the component of catastrophising that is most strongly associated with disability (89).

Catastrophising is also associated with a heightened pain response and a greater likelihood of unemployment. Even after controlling for pain, catastrophising predicts ratings of occupational dysfunction (89).

There is a link between initial catastrophising scores and future depression scores. It is suggested that clinicians be observant of patients with high catastrophising scores as they may reflect a depressed state of mind preventing the use of other, more adaptive, cognitive coping strategies. Similarly, fear-avoidant behaviour associated with pain catastrophising may slow the recovery from WAD as it may interfere with the ability of patients to engage in active treatment strategies (57).
Soderlund and Lindberg (2003) suggest that there is a need for an intervention that alters a patient’s coping strategies early since catastrophising appears to be a powerful cognitive disturbance that influences disability (88). However, the tendency for catastrophisers to focus on pain sensations may interfere with the efficacy of coping strategies, which may further contribute to increased disability. Increased attention to pain may also foster the development of a helpless orientation toward the management of pain, and in turn, contribute to disability.

2.1.4.5. **Kinesiophobia**

Highly misinterpreted pain may result in dysfunctional pain-related fear and safety seeking behaviours such as avoidance and hyper-vigilance. Such behaviours may be functional in the acute injury phase, where pain is directly related to the injury and where avoidance behaviours may be necessary to facilitate healing. However, when avoidance behaviours persist beyond the acute injury phase the problem of enduring pain which is not related to the initial injury, may worsen. In contrast, when pain is perceived as non-threatening, patients are more likely to maintain an active lifestyle which consequently promotes recovery (90).

Kinesiophobia is a commonly seen factor among patients with MSK pain. Lundberg et al. (2006) found that a high degree of kinesiophobia was observed in approximately 50 percent of patients presenting with MSK pain to physiotherapy departments within a primary healthcare setting in Sweden (91). This high proportion of patients demonstrating kinesiophobia has also been reported by Boersma et al. (2005) in a separate study of Swedish patients with acute/subacute non-specific back or neck pain, of whom 40 percent
demonstrated kinesiophobia (72). Given that both studies were based in Sweden, it is difficult to know if this high proportion of kinesiophobia can be extrapolated to other cultures. Factors associated with kinesiophobia include disability, pain severity, pain intensity, life control, affective distress and depressed mood (91). Unsurprisingly, patients that are non-exercisers appear to demonstrate the highest level of kinesiophobia (92).

Kinesiophobia is considered a predictor of poor recovery from both back and neck pain in most studies. Nederhand et al. (2004) demonstrated in a study of 90 consecutive people reporting pain in the neck or head region after a RTC, that patients who were disabled according to the NDI at 24 weeks were more likely to have given a higher response on the TSK at baseline than patients who had recovered at 24 weeks (57). This study also found that combining measures of baseline neck pain disability with fear of movement significantly improves the prediction of outcome. In the study by Boersma et al. (2005) patients were classified according to four variables including: their level of pain; fear-avoidance; functional problems; and depression (72). This study demonstrated that kinesiophobic behaviour was related to future pain related disability. The majority (62%) of patients classified as “Distressed-Fear-Avoidant”, which meant that they were high scoring in all four variables at the initial examination, were on sick leave one year later. For patients classified as “Fear-Avoidant” (high scoring on all variables except depression), 35 percent reported being on sick leave after one year. Almost none of the patients with low levels of fear avoidance reported being on sick leave at the one-year follow-up (72).

Crombez et al. (1999) found a significant association between kinesiophobia as measured by TSK, and pain onset for patients with chronic back pain (93). Patients whose pain began
suddenly, and who remembered the date of pain onset, had higher TSK scores than those who reported a gradual onset of pain. In their study, disability was significantly correlated to all the pain-related fear measures but not to pain intensity. Interestingly, there was no significant relationship between pain-related fear and the expectation of pain. The authors conclude that pain-related fear is potentially more disabling than pain itself and is related to poor behavioural performance (93).

Only one study reports a contrasting finding. Sterling et al. (2005) failed to find any influence of fear of movement on outcome of whiplash injury at six months (23). The authors suggest that differences between whiplash injury and other MSK conditions such as low back pain may explain the discrepancy in the findings of this study compared to others such as Crombez et al. (1999) (93) where kinesiophobia was found to be a significant predictor of disability. However, this does not explain the difference between the results presented by Nederhand et al. (2004) (57). The authors suggest that the difference may be due to only two variables being investigated in the study by Nederhand et al. (2004) (NDI and TSK) and that the inclusion of a measure of post-traumatic stress by Sterling et al. (2005) may have contributed to the difference in results (23).

From the literature it appears that there is increasing evidence to support kinesiophobia as a predictor of outcome for MSK injuries. It is clear, however, that other factors, for example depression, when combined with kinesiophobia, may augment the vulnerability of patients to develop a pattern of chronic injury. The presence of kinesiophobia may interfere with intervention programs, particularly those focussed on active treatments. Therefore, providing patients that demonstrate kinesiophobia with a structured treatment
program that is focussed on the gradual confrontation of fear-eliciting activities may increase the efficacy of active treatments (57).

2.1.4.6. Patient expectation

It is thought that psychosocial factors operate within some cultures to produce certain behaviours following acute injury that generate the pattern of symptoms seen in the chronic syndrome. One of the psychosocial factors thought to generate chronic illness behaviour is symptom expectation. Ferrari et al. (2002) surveyed uninjured people in Greece and Canada to determine the type and longevity of symptoms people expect following a hypothetical whiplash injury (94). The results of the study demonstrated that expectation of both nationalities of subjects with regard to acute symptoms following whiplash injury closely resemble the actual symptoms commonly reported in both cultures; however, the Canadian subjects were more likely to expect symptoms to last for months to years whereas very few Greek subjects believed that symptoms were likely to persist. The authors suggest that this increased expectation of poor outcome seen in Canadian patients may partly explain the increased prevalence of chronic whiplash disorder seen in Canada. Similar findings have been reported for patients in Canada and Lithuania following minor head injury caused by RTCs. Although patients in Lithuania and Canada had similar expectations of the acute post-crash symptoms, patients in Canada had a significantly greater expectation of chronic symptoms. The Canadians more frequently anticipated chronic cognitive dysfunction, which when combined with poor expectation of outcome results in patients with acute head injury becoming hyper-vigilant for symptoms, leading to symptom amplification and consequently a syndrome of chronic
illness (95). The cultural aspects responsible for causing these differences in expectation remain unclear, as does the role of the prevailing compensation scheme.

Bostik et al. (2009) also found that patients are generally pessimistic about their recovery (96). More than 60 percent of patients with WAD believed that they would experience long periods off work. Only 18 percent of patients believed that they would recover quickly and return to normal activities. Such poor expectation of outcome has been shown to influence disability following whiplash injury at six months. Holm et al. (2008) found that after controlling for severity of physical and mental symptoms, individuals who believed that they were less likely to make a full recovery were consequently more likely to have a higher disability compared to individuals who believed that they were very likely to make a full recovery (odds ratio 4.2 [95% confidence interval 2.1 to 8.5] (97). This is supported by the findings of Hill et al. (2007) in which expectation of treatment success was a significant independent predictor of both six-week and six-month outcome (28). A similar finding has been reported by Rubinstein et al. (2008) (63).

Although patient expectation can influence outcome, poor expectation alone may be insufficient to alter the outcome in all patients. It is likely that the extent of exposure to other factors that maintain hyper-vigilance and anxiety accounts for some of the variation in outcome observed for patients with a poor expectation of their long-term outcome (98).

2.1.4.7. Coping style

At its most basic level, coping strategies can be classified as either passive or active. Passive coping strategies are typified by patients withdrawing from activities due to pain
or relying on others for pain management. Patients are likely to restrict or cancel social
engagements due to pain and often wish for better pain medication. In contrast, active
coping strategies more frequently involve attempts to control the pain or to function in
spite of the pain. Patients are more likely to engage in physical exercise or physical
therapy and stay busy or active (99). Although passive coping styles are accepted as
having a negative effect on outcome, the benefits of active coping styles are less easy to
confirm.

Carroll et al. (2006) found that early use of passive coping strategies was independently
associated with slower recovery. In this study coping was measured at six weeks using the
Pain Management Inventory. Patients using high levels of passive coping recovered 37
percent slower than those using low levels of passive coping. Interestingly, the presence
of depressive symptoms resulted in a worse outcome, particularly when combined with
passive coping strategies. Patients in which depressive symptoms were present, and that
used high levels of passive coping, recovered 75 percent more slowly than those who
coped less passively (99).

Active coping styles are less consistently associated with improved outcome. Soderlund et
al. (2000) found that patients who were asymptomatic at six months appeared to have a
slightly more active coping style than patients who remained symptomatic (100). This is
supported by Olsson et al. (2002) who found that patients who were classified as being
“adaptive copers”, meaning that they were relatively low in pain severity and
interference, high in life control, low in affective distress, and high in general activity, had
a better prognosis than patients categorised as “dysfunctional” or “interpersonally
distressed" (66). In contrast, three other studies (56, 99, 101) were unable to demonstrate any relationship between active coping style and duration of neck complaints and recovery.

It is possible that the timing of particular coping strategies is important in determining recovery. Carroll et al. (2006) suggest that a later increase in active types of coping strategies may produce a beneficial effect even though early active coping has little impact (99). This may also explain the findings of the study by Kivioja et al. (2005) in which prognosis was not altered by differences in coping patterns during the early phase after whiplash injury (56). Conversely, however, Buiten­huis et al. (2003) suggest that the coping style within the first few weeks of an accident affects the development of late whiplash syndrome, after which the intensity of somatic complaints determines the duration of neck complaints. Interestingly, patients who seek distraction, avoid thinking about their problem and try to feel better by smoking, drinking, or relaxing, have a longer duration of neck complaints than patients who seek social comfort and understanding and share their concerns with others (101). The ability to seek social comfort may in part explain some of the cultural differences in the outcomes of whiplash injuries.

It appears clear from the literature that coping style should be considered a process which is influenced by a number of factors including pain type, intensity, duration and disability (99). The coping process changes throughout the course of injury, with passive coping strategies predominating in the acute stages of injury with patients adopting more active strategies as time passes from the acute to chronic injury (88, 99).
2.1.4.8. Self-efficacy

Self-efficacy reflects the belief of how successfully one can cope with difficult situations. Individuals with high self-efficacy are more likely to be persistent in difficult situations than individuals with low self-efficacy (100). A number of studies have demonstrated that self-efficacy influences the outcome of MSK injuries.

Soderlund et al. (2000) reported that patients with acute whiplash injury who remained symptomatic after six months had a lower baseline self-efficacy than patients who were non-symptomatic, regardless of the initial WAD grade, initial pain intensity or physical measures. The authors suggest that self-efficacy is a better predictor of long-term symptomatology than the initial medical assessment or pain intensity (100). A more recent study of 74 patients with acute whiplash injuries by Soderlund et al. (2010) reported that self-efficacy was a mediator between pain intensity and pain-related disability (102). In a study of 47 patients with sub-acute whiplash injuries, Kall & Kall (2009) found that 40 percent of the variation in quality of life based on the Short Form Health survey (SF-12) outcomes was explained by self-efficacy (103). Higher self-efficacy has also been associated with less pain-related avoidant behaviour (104).

Studies of chronic WAD also demonstrate a relationship between high self-efficacy and outcome. In a study of 433 patients with chronic pain of whom 150 had chronic WAD, Borsbo et al. (2010) found that self-efficacy was negatively correlated with duration of pain, pain intensity and spreading of pain (105). Thompson et al. (2010) reported that in patients with chronic WAD, lower functional self-efficacy beliefs were significantly related to greater levels of disability (106).
2.1.5. Compensation Factors

A number of systematic reviews have examined recovery in people injured in work and traffic incidents, each with conflicting conclusions on the role of compensation (1-3, 62). While acknowledging that the prevailing compensation system from which injured people are allowed to claim benefits will influence recovery outcome, Cote et al. (2001) found strong and independent associations between retention of a lawyer and delayed recovery; ‘not at fault’ claimants and slow recovery; and time to claim closure and time to recovery (2). Similarly, Carroll et al. (2008) determined that there was preliminary evidence that the compensation system framework is prognostic for recovery (1). These results are at odds with Scholten-Peeters et al. (2003) who found strong evidence to suggest that there is no prognostic value for compensation (62). However, in a meta-analysis investigating the association between compensation and outcome after surgery, it was revealed that compensated patients had more than three times the odds of an unsatisfactory outcome compared with non-compensated patients (107).

An interesting consideration made by Kamper et al. (2008) in their review of prognostic factors for outcome in WAD was the exclusion of compensation factors as a possible predictor. They held the view that factors collected during the course of recovery (e.g. compensation) as opposed to at baseline, may be influenced by the course of the condition itself and therefore represent a different relationship to outcome (3).

The reasons for poor outcome, if indeed it is acknowledged that there is a poor outcome, are multi-factorial. It is not sufficient to conclude that compensation is bad for health. There are individual elements of compensation schemes that are not conducive to a
positive health outcome such as length of exposure to the system, involvement of
lawyers, and access to medical care. Within the insurance industry, elements of the claims
management process, attitudes of insurers, and health provider behaviour may also
contribute to the poor outcome. Schemes have evolved over years to address some of
the negative design aspects thought to influence recovery.

The influence of scheme design on recovery outcomes was assessed in an interrupted
time series study in NSW claimants (108). In 1999 the government legislated and
introduced four primary changes to the CTP scheme; restriction of access to claims for
non-economic loss for minor injuries; introduction of clinical practice treatment
guidelines; legislative changes which encouraged earlier notification and acceptance of
claims, which had the effect of enabling earlier access to medical treatment. Significant
improvements were seen in disability, pain and physical functioning post legislation. No
significant differences were shown in mental function, but the authors suggest that
psychological stressors related to injury where another person was to blame, may
influence mental function. While there was an overall improvement in health status post
legislation, the independent effects of the components of the legislative changes could
not be measured. The magnitude of improvement post legislative change was such that
an additional 15 percent or one in seven people with whiplash had recovered two years
after injury.

These results confirm earlier research in Canada which investigated the effect of removing
compensation for pain and suffering on the outcome of claims (19). A change in
legislation provided the impetus to measure the difference in outcome pre and post
scheme change. The changes were two-fold; compensation for pain and suffering were removed; and payments for medical care and income replacement were increased. The change resulted in a 28 percent decrease in the incidence of whiplash claims and a 54 percent decrease in the time to claim closure.

The influence of lawyers in compensation claims has been studied by a number of researchers in an effort to try to understand some of the individual components of the compensation system that might influence health (25, 42, 53, 109, 110). In a group of whiplash patients followed prospectively, Gun et al. (2005) demonstrated that lawyer intervention was associated with a seven point reduction in Neck Pain Outcome Score (a reflection of function), but there was little effect on change in Visual Analogue Pain Score. The authors suggest that hiring a lawyer may significantly influence functional recovery without affecting the perception of pain. Furthermore, consulting a lawyer was associated with a lesser chance of claim settlement and a greater chance of still having treatment after one year (42). The results are consistent with those from a study of people with fractures following a RTC, where claiming compensation was strongly associated with poor outcome on univariate analysis but was not significant on multivariate analysis (110).

However, lawyer retention was a strong predictor of poor physical and mental health after adjusting for other factors. That is, the effect of using a lawyer was stronger than the effect of claiming compensation. The authors suggest that the lawyer effect may be attributable to prolongation of the exposure of the injured person to an adversarial claims process, or to coaching and symptom amplification by legal providers. It is also possible that the reason that compensation per se was not shown to be predictive was due to the
limited exposure time of patients to the compensation system (patients were followed for only six months).

Dufton et al. (2006) retrospectively studied over 2000 patients presenting to rehabilitation clinics in Canada to identify prognostic factors for recovery from WAD (53). Lawyer retention and being employed at entry to the clinic were the strongest predictors of negative outcome, and both effects were modified by initial pain intensity. The lower the initial pain the stronger the effect of lawyer retention and 'at work' status. Additionally, patients who waited the longest to seek treatment were less likely to demonstrate improvement, with each additional month of lag time resulting in a 20 percent increase in the odds of poor outcome.

The influence of legal providers is evident in other injury settings. In a study of multiple trauma patients and the development of PTSD, Harris et al. (2008) showed PTSD to be significantly associated with the use of a lawyer, blaming others for the injury and having an unsettled claim (79). There were no significant associations between the development of PTSD and any of the injury severity factors. The pursuit of claim (either fault-based or non-fault based) wasn't associated with development of PTSD, only an unsettled claim. The suggestion is that compensation per se does not predict development of psychological distress, but rather the ongoing claim process and use of a lawyer. The circumstances surrounding the injury, for example blame, and the processes that follow the injury (lawyer involvement to manage the claim) as opposed to the severity of the injury may be important influencers in the development of PTSD.
In a South Australian retrospective analysis of insurance data risk factors for prolonged recovery, the association between late claim settlement and legal providers was examined (25). Two groups of claimants were compared; the first with claims that had settled within nine months of the crash; the second group settled within 24 months. Consulting a lawyer was associated with a significant four-fold increase of late claim settlement. Weaker associations were shown with a concurrent workers compensation claim, prior neck disability and undergoing physiotherapy or chiropractic treatment. As discussed earlier, no relationship was shown between injury severity and recovery; and no association between crash severity and late settlement.

Taking the findings that compensation affects health outcome a step further, Harris et al. (2009) went on to look at how compensation status influences healthcare utilisation(109). In their retrospective study of major trauma patients, they found there was a direct association between healthcare utilisation and the use of a lawyer or having an unsettled claim.

The results described in the above studies are supported in the previously cited study from Canada that investigated outcome following changes to the compensation system which resulted in a no-fault scheme that limited access to pain and suffering payments (19). This had the effect of reducing most court actions, and therefore limiting the need for lawyers in the claims process. However, under both systems of legislation (pre and post change), involving a lawyer in the compensation process was a strong predictor of delayed claim closure. The findings of these studies support the implementation of
compensation scheme designs which minimise litigation and the involvement of lawyers, particularly for minor injury claims.

In a study of orthopaedic trauma, Williamson et al found that the only modifiable factors that predicted ongoing severe pain at six months was compensation status and moderate or severe pain at discharge from the hospital. This was after controlling for injury severity and pre-injury health (anxiety, depression and pain-related disability) (111). While the measure of pre-injury health could be considered weak (on discharge from hospital patients described their health status in the week before injury by completing the SF-12 and self-reported response to items of anxiety, depression and pain-related disability were recorded as a measure of pre-injury health), the results are consistent with previous studies demonstrating the association between compensation and health.

Further evidence of the association is shown in a prospective study from the United Kingdom investigating neck pain in people reporting a rear end collision to the police. The presence of a compensation claim and initial neck VAS pain score were the strongest predictors of pain at one-year post-crash (58). At two years people who settled their claim were more likely to have neck pain at least once a week than those who had not settled. The authors suggest that stress and anxiety related to the claim itself prolongs symptoms. They also conclude that once a pain pattern is established it does not resolve with claim settlement. So, compensation is associated with pain at one-year, however pain does not necessarily resolve once a claim is settled. These results are consistent with earlier work by Greenough et al. (1989) (112). In studying recovery following low back injury, they reported that claim settlement was not associated with any reduction in
morbidity. They concluded that compensation systems that are built on lump sum payment act directly and powerfully against the long-term interests of the patient.

Pain and functional disability was assessed in four distinct groups of twenty people with cervical spine injury (43). Group 1 had a stable fracture of the cervical spine (no neurological loss) and were treated with immobilisation in a cervical collar; Group 2 had unstable cervical spine fractures (no neurological loss) treated with internal fixation; Group 3 had a whiplash injury and were seeking compensation; Group 4 had a whiplash injury and were not seeking compensation. NDI scores were no different between groups 1 and 2; significantly worse scores were seen in Group 3 compared to Groups 1 and 2; significantly worse scores were also seen in Group 3 compared to Group 4; no differences were seen between Group 4 and Groups 1 and 2. The reasons for the differences may be due to pathophysiology of the injury, treatment regime or psychological factors.

When the association between compensation in a no-fault insurance scheme and health outcome for patients with orthopaedic trauma was studied, similar results were found (113). Compensable patients were more likely than non-compensable patients to report moderate or severe disability based on SF-36 physical and mental scores, and were less likely to return to work by 12 months. However, the no-fault scheme in Victoria (where the study was performed) did allow for people who could prove they were not at fault to pursue further compensation through the courts. The study did not differentiate between those people who claimed compensation through the courts and those that did not, and the findings could be influenced by this. Regardless, the study demonstrated the negative association between compensation and health.
Studies in Germany have produced similar results (114, 115). In the study by Schnabel et al. (2004) comparing collar therapy to an exercise group in whiplash patients, 56 percent of participants were asymptomatic at six weeks, regardless of which therapy group they were assigned to. This study wasn’t specifically investigating the effect of compensation, but it raises some interesting questions. In Germany the incidence of whiplash injury is similar to that in other western countries, it has a compensation system that includes whiplash injuries, yet people in that country do not tend to go on to develop chronic whiplash. This suggests that there is a cultural component to recovery; the compensation system alone cannot be held responsible for poor recovery rates.

Harris et al. (2007) explored another angle, investigating patient satisfaction after major trauma (116). They found that having an unsettled compensation claim after major trauma was the strongest predictor of patient dissatisfaction. So it appears that the claims process not only influences health status, but also how patients view their treatment and assess satisfaction with their progress.

The relationship between compensation and health outcome is indeed a complex one. O’Donnell et al. (2010) concluded that there was no association between access to compensation and poor recovery (117). Caution should be used when interpreting the results of this study as the original observed effect of compensation disappeared after participants who received payments (compensation) from Australian private health insurance and other agencies were removed from the non-compensable group. The concept of classifying private health insurance as compensation is unusual and has been challenged by some researchers (118-120). However, the suggestion by the authors that
stress caused by dealing with compensation agencies may contribute to mental health outcomes is worth considering.

Overall, the evidence is strong that compensation influences health, although there is less clarity around the individual components of the compensation system that drive the negative association.

2.2. **Treatments**

This section reviews the literature pertaining to treatment strategies for injured people in the early post-crash period. Only interventions delivered within three months of injury are considered. For the purpose of this literature review, treatment strategies will be presented according to the effectiveness of: educational interventions; physical therapies; early mobilisation over cervical collar use; population based interventions.

2.2.1. **Effectiveness of educational interventions**

Many patients that seek medical attention for injuries sustained in RTCs are provided with some form of educational material. The material is designed to inform and reassure patients of the nature of their injuries, provide advice on pain relief, posture, early return to usual activities and to give examples of exercises that can be performed in the home environment. There are three forms in which this information is usually provided to the patient: written, audio-visual (video) and verbal. Although an observational study by McClune et al. (2003) (121), demonstrated improved patient beliefs about whiplash though the use of "The Whiplash Book", the clinical benefit of providing patients with educational material in the early post-crash period remains inconclusive.
In recent years a number of studies have evaluated educational interventions for the treatment of MSK injury after RTCs (122-126). Of these, only one study demonstrated a statistically significant benefit of patient education. The number and type of outcomes measured in these studies varied considerably, making direct comparison between studies difficult; however, they most frequently included measurement of return to work, use of pain medication, severity of neck, shoulder and upper back pain, cervical range of motion (ROM) and disability.

In three of the studies, the educational information provided advice for patients to return to normal activities as quickly as possible, a recommendation frequently given in the literature. The aim of the information was to reassure patients of the benign nature of their injuries and to emphasise a favourable prognosis, encourage patients to stay active and perform simple neck and shoulder exercises, and not to be frightened of movement or pain. There were, however, differences in the medium via which this information was transmitted to patients.

Ferrari et al. (2005) (123), evaluated the benefits of simple, written patient education. Patients presenting to the ED were randomised to one of two groups. Patients in the intervention group received a one-page evidence based whiplash prevention pamphlet based on "The Whiplash Book" that summarised the "dos" and "don’ts" following WAD injuries. Patients in the control group were provided a generic one-page information sheet that defined whiplash, its symptoms, possible treatments and signs that should prompt a return to hospital. In both groups the information was given to patients at the time of discharge from the ED. At three months there were no significant differences in symptom
severity, use of pain medication or time lost from work between the groups and the authors found no evidence to support the use of the pamphlet despite it being based on a previously validated source.

Brison et al. (2005) (122) randomly allocated patients presenting to the ED to either receive a 20-minute educational video plus usual care, or usual care alone. The information presented in the video which was mailed to patients following discharge from hospital, was of a similar nature to the written information provided by Ferrari et al. (2005) (123). Despite a trend for greater improvement in the video intervention group, there were no significant differences in the primary outcome measures at 24 weeks. The median improvement in pain score at 24 weeks was, however, significantly greater for the intervention group.

In contrast, a 12-minute psychoeducational video that was presented at the bedside of patients recruited from EDs in San Diego, had a dramatic effect on pain severity, patient satisfaction, work days missed and use of pain medication (124). Pain was 70 percent lower; there was 85 percent less narcotic use; and 100 percent fewer surgical consultations in the video group compared to the group receiving usual care. These results were more profound than those where the video was mailed to patients (122). The authors suggest this might be due to the different recruitment settings between these studies, whereby patients were selected from a “suburban” setting as opposed to an urban teaching hospital (122). Additionally, the content of the 12-minute video, focussed on the mechanisms behind continuous MSK pain, trigger points, physical and emotional triggers of muscle tension and provided breathing and relaxation techniques along with
exercises to reduce muscle tension. These factors may have improved the effectiveness of the video.

The different findings in these three studies prompted Kongsted et al. (2008) to evaluate whether the method of advice communication affects outcome (125). In their study, 182 patients were randomised to receive either a 1-hour educational session with a specially trained nurse at a home visit, or an educational booklet. As for the previous three studies, the aim of the advice was to reduce fear and uncertainty, and encourage patients to return to normal activities. The same advice was provided in booklet form to the control group. Patients were followed up at three, six and 12 months and although there was a consistent tendency toward a better outcome in the oral advice group, no significant differences were observed between the groups for any of the outcome variables. In this study, patients in the control group were also visited by the nurse, and consequently received more attention than they otherwise would have in the normal ED setting. Therefore, the benefits of personally communicated advice compared with usual care may actually be greater than could be demonstrated in this study.

The effect of who delivers the educational advice was evaluated by Scholten-Peeters et al. (2006) (126), in a study in which the effectiveness of education and advice given by general practitioners (GPs) was compared to education, advice and active physical therapy given by physiotherapists. Although no significant differences in neck pain, headache or work activities in daily living were found between the two groups, physiotherapy was more effective at improving cervical ROM at short-term follow-up, while GPs had a more positive effect on long-term coping, functional recovery and physical functioning.
However, the authors make the point that the GP care in the study did not represent usual care, as the GPs in this study were trained to administer the treatment protocols and had enhanced knowledge of whiplash and its treatment. The authors therefore recommend that specific courses on whiplash should be provided for all GPs.

Based on these studies, there appears to be some benefit in providing patients with material that is informative about the psychological, emotional and behavioural aspects of recovery following a crash. The findings suggest that the provision of educational material may benefit some patients, particularly when the material is personally communicated, contains information relating to the psychological wellbeing of the patient and provides strategies to alleviate emotional and physical tension in the early healing period.

2.2.2. Effectiveness of physical therapies

Active physical therapy in the acute injury phase is frequently recommended in the literature for the treatment of MSK injury; however, there is still limited evidence from high quality studies to support this recommendation. Of the studies that compared physical therapy with standard care alone, the majority found some benefit to physical therapy in the acute phase. As can be expected, the nature of the physical therapies varied between studies. However, typically they included gentle neck and shoulder exercises to increase ROM and decrease muscle tension.

The influence of the time interval between injury and the initiation of the physical therapy was evaluated by Rosenfeld et al. (2000) in their study comparing early active mobilisation with a standard treatment protocol (127). The active treatment incorporated the ideas of
early and repeated movements, postural control and cervical rotation exercises, with an emphasis on home exercise. If symptoms were unresolved, further evaluation and an individual treatment programme were initiated according to the McKenzie principles (128). Patients were randomised to one of four groups; groups 1 and 2 compared active and standard treatment given within 96 hours of injury; groups 3 and 4 compared active and standard therapy initiated after a delay of 14 days. Cervical range of motion (ROM) and pain intensity were the primary outcome measures. Patients receiving active treatment experienced a greater reduction in pain at six months, although there was no significant difference in range of motion between the two treatments. The authors suggest that patients will regain adequate ROM irrespective of treatment. A key finding in this study was that although the type of intervention did not affect outcome, if active intervention was used it was best administered in the acute injury phase.

Long-term follow-up of the patients in the study by Rosenfeld et al. (2003), demonstrated that the greater reduction in pain following active treatment remained evident at three years (129). Although not statistically significant, measurement of ROM showed a trend favouring active treatment. Interestingly, cervical ROM in the active treatment group was not significantly different to that of normal, uninjured controls. Furthermore, patients in the active treatment group had a significantly reduced need for sick leave than patients receiving the standard treatment. An economic evaluation by the same authors reported that as well as being more effective, active treatment was also less costly, a finding which they attribute to the significantly reduced need for sick leave in these patients (130).
The type of physical therapy provided to patients may influence their recovery from WAD. Soderlund et al. (2000) (100), tested the efficacy of a home based exercise programme designed to improve the kinaesthetic sensibility and co-ordination of the neck muscles in patients following whiplash injury. The rationale for this treatment was that previous studies had demonstrated that WAD patients had less precise kinaesthetic ability and proprioceptive deficits, resulting in impaired co-ordination of head movement patterns which may perpetuate neck pain. The physical and psychological outcomes of patients assigned to the kinaesthetic treatment group were compared with those of patients randomised to a standard active mobilisation regimen. Although the authors did not find a difference in improvement between the two treatment groups, the additional kinaesthetic exercise resulted in a significantly increased ability to reduce pain between the three-month and six-month follow-ups. Evaluation of self-efficacy in the patients from this study revealed that patients who were non-symptomatic based on pain intensity at six months had significantly higher initial self-efficacy scores than patients who were symptomatic at six months. In addition, the symptomatic patients had significantly higher disability related to pain scores at baseline. The authors suggest that self-efficacy is a good predictor of long-term symptomatology and should be taken into consideration when designing a rehabilitation programme particularly for the acute injury phase.

The long-term benefits of improving self-efficacy are, however, questionable. The effects of a supervised physical training program tailored to meet the needs of patients with sub-acute WAD were studied by Bunketorp et al. (2006) (131) in Sweden. Forty-seven patients attending a multidisciplinary rehabilitation clinic for treatment of whiplash injuries were randomised into a supervised training group or a self-administered home training group.
Patients were included if their injury occurred between six weeks and 12 weeks previously. The supervised group attended a clinic twice a week for approximately an hour and a half where they received instruction and an individually adjusted training program from a physiotherapist. The program was primarily designed to overcome fear of pain and movement and increase self-efficacy. There was a significant improvement in self-efficacy, fear of movement and pain disability at three months for the group receiving supervised training. Analgesic use was significantly lower in this treatment group. However, by nine months this improvement was no longer evident, and despite self-efficacy remaining stable, patients in the supervised training group had an increase in fear of movement, combined with an increase in the consumption of analgesics. The authors suggest that the sudden cessation of positive support when the treatment ended is likely to have contributed to the increase in fear of movement and analgesic consumption in this group. Furthermore, sick leave was not reduced at either time-point, despite the favourable outcomes at the three-month assessment. Strikingly, only six of the 28 patients in the treatment group had returned to work at nine months.

These studies clearly demonstrate that early, active treatment can improve subjective outcomes such as pain perception. Although patients in the control groups of these studies were not physically more disabled at follow-up based on similarities in objective outcome measures, their disability associated with pain was worse, which is evidenced by the increased level of sick leave in these patients. The psychological factors at play are supported by the differences that active treatment made to self-efficacy, which is further supported by the negative psychological effect of withdrawing treatment. Improvement in physical functioning is more difficult to demonstrate in these studies, however, the long-
term study by Rosenfeld et al. 2003) (129) suggests that early active physical therapy may be beneficial in some patients.

2.2.3. Effectiveness of early mobilisation versus cervical collar use

In recent years the use of soft cervical collars in the treatment of WAD has reduced in popularity, particularly as their use has been implicated in delayed recovery. While a number of studies have included the use of a cervical collar in either the treatment or control group, only three studies found better outcomes for patients assigned to treatment groups which did not involve prolonged cervical collar use during the acute injury phase. Each of the three studies incorporated an exercise or physical therapy component to the treatment.

Borchgrevink et al. (1998) (132), compared the clinical outcome in two groups of patients who either received instruction to “carry on as usual” or were immobilised with a soft collar and received 14 days of sick leave. The act as usual group received no sick leave. Both groups of patients received instructions for self exercises and five days of non-steroidal anti-inflammatory medications. Neck mobility and duration of sick leave were not significantly different between the groups. Given that significant differences between the groups were only found for subjective variables such as neck pain and headache, the authors suggest that this may be a result of psychological factors whereby immobilisation in a neck collar and sick leave may cause patients to negatively focus on their injuries. The similarity in neck mobility between the groups may have been a result of the self exercises that both groups of patients were instructed to perform.
Similarly, Vassiliou et al. (2006) (133), found that 10 sessions of physical therapy and active exercises with a physical therapist during the first 14 days after injury, in addition to home exercises, resulted in significantly lower pain and disability scores in patients six weeks after injury when compared with standard care that included the use of a soft collar for the first seven days followed by no further specific treatment. This effect was maintained at six months. In addition, significantly more patients in the physical therapy group were pain free at both six weeks and six months.

The third study in which early mobilisation resulted in a better outcome was by Schnabel et al. (2004) (114), in which patients from an ED were randomised to either receive a cervical collar which was to be worn day and night for seven days, or to undergo active exercise therapy. The active therapy group received instruction on exercises for mobilisation during two to five treatment sessions with a physiotherapist during the first week. The authors attempted to create a worst case scenario for collar use, in which patients were provided with no advice that might mitigate any adverse effects of collar use. The results demonstrated that patients in the active exercise group had significantly less neck pain, headache and shoulder pain, and trends for a lower prevalence of all other symptoms. There was also significantly less analgesic use in the exercise group. It is possible that time spent with the physiotherapist had a beneficial psychological effect on patients that influenced the outcome variables measured in this study. It was noteworthy that the recovery rate was very rapid, with 65 percent of patients being symptom free at six weeks.
However a detrimental effect from the use of collars has not always been shown. Gennis et al. (1996) (134), compared the effects of rest and analgesia alone, with rest, analgesia and collar use for 14 days. In this study, neither the degree of pain or recovery was significantly different between the two groups. In contrast to the study by Schnabel et al. (2004) (114), only 38 percent of patients had fully recovered by at least six weeks, suggesting that although the collar was not considered detrimental to recovery in this study, the regime of rest and collar is not beneficial to recovery either.

Crawford et al. (2004) (135), compared early mobilisation with soft collar use on functional recovery after soft tissue neck injuries. Although all patients were initially immobilised in a collar whilst in the ED, patients randomised to the early mobilisation group were then allowed to mobilise freely and were instructed to perform a self mobilising exercise regime. The collar group were immobilised in a collar for three weeks after which they were also instructed to follow the same exercise programme. There were no significant differences in functional outcome between the groups. The percentage of patients returning to a normal level of function after one year was also similar between the groups (83 percent for the active mobilisation group and 86 percent for the collar group). As for the study by Borchgrevink et al. (1998) (132), range of movement was similar between the groups, and in both groups there was evidence of improvement at successive follow-ups. A significant finding in this study was that the collar group took significantly longer to return to work, supporting the advice in The Whiplash Book that suggests that collar use may delay recovery.
Kongsted et al. (2007) (136), found no differences in terms of headache, neck pain, disability or work capability between patients treated with active mobilisation, semi-rigid collar immobilisation or “act-as-usual”. Across all three groups, the majority of improvement occurred in the first three months. The outcome of patients in this study was relatively poor, with 48 percent of patients reporting considerable neck pain after 12 months. This may be explained by the selection of patients with marked symptoms. Therefore the results of this study may be difficult to extrapolate to the majority of patients suffering from whiplash injuries. The results of this study were further complicated by poor compliance and frequent use of co-interventions. Interestingly, patients that were poorly compliant with collar use reported a better outcome than all other patients, while those reporting the use of co-interventions after three months recovered less well on a number of variables including neck pain and headache. The improved outcome seen in the non-compliant patients once again highlights the influence of psychological factors on the outcome of soft tissue injuries, as the authors speculate that poor compliance to the collar was more likely to occur in patients with less fear-avoidance behaviour, a factor suggested to have a positive effect on prognosis.

These studies again suggest that physical function is not strongly influenced by treatment and that improvement in function occurs almost despite the interventions imposed. They also highlight the effect on patients’ subjective perception of pain, where active treatment can have a positive influence. However, once again it is difficult to separate the effect of physical exercise from the potential psychological benefits of contact with a health care professional, noting that sometimes the healthcare professional may make detrimental recommendations. Although there is evidence from some studies to suggest that the use
of a collar is not detrimental to function, the overall wellbeing of patients is hindered by this intervention as is evidenced by a delay in the return to work.

2.2.4. Effectiveness of population based interventions

A small number of population based intervention studies have been performed and together, these studies demonstrate that the type and intensity of care received influences the prognosis of MSK injury in the post-crash setting.

In an evaluation of eight patterns of care that differed in the type of health care provider (GP, chiropractor and specialist), and in the number of visits (high utilisation or low utilisation), Cote et al. (2005) (137), found that early aggressive care does not promote faster recovery, which was defined as days from injury to claim closure. The high GP utilisation group was 27 percent less likely to have recovered after one year compared to the low GP utilisation group. The largest delays were seen in the high chiropractor utilisation and the high combined GP and chiropractor utilisation groups. Compared with the low GP utilisation group, the high chiropractor utilisation group had a 39 percent slower rate of recovery. The authors suggest that clinicians who promote frequent visits inadvertently encourage patients to cope passively with their pain. The passive coping style may lead patients to demand more clinical care. This reliance on clinical care can lead patients to believe that they have a serious injury and as a consequence, illness behaviours then manifest. This finding, that the type and intensity of care in the month after injury influences prognosis for recovery, was reproduced by Cote et al. in 2007 (138).
Cassidy et al. (2007) (139), also found no evidence to support the effectiveness of population based rehabilitation or fitness training programs for WAD. In this study, the effectiveness of a government policy for funding community and hospital-based fitness training and multidisciplinary rehabilitation was assessed. Patients could be referred by their primary care practitioner to any of three treatments: fitness training in a health club; multidisciplinary outpatient rehabilitation; and multidisciplinary inpatient rehabilitation. Patients referred into rehabilitation were assessed by an independent multidisciplinary healthcare team to approve the program. Recovery was based on patient responses to a 6 point Likert-type scale measured by asking “how well do you feel you are recovering from your injury?” Patients attending fitness training before 70 days post-injury recovered 32 percent slower than those that did not attend. Patients attending outpatient rehabilitation experienced a 50 percent slower recovery. Fewer than 50 percent of those that went to inpatient rehabilitation were recovered at 12 months. Interestingly, patients attending the rehabilitation programs were more likely to experience some form of negative psychological component to their injury, such as depressive symptoms, greater pain and less optimism about their future recovery than patients that did not attend a rehabilitation program.

These studies suggest that aggressively addressing only the physical aspects of WAD, in particular, by methods that include frequent visits with GPs and chiropractors, is ineffective at improving the rate of recovery and, therefore, the economic burden of whiplash injuries.
Suissa et al. (2006) (140), evaluated the effectiveness of a multidisciplinary clinical management approach for WAD that included patient access to occupational therapists and psychologists. In this two-group, parallel design study, patients referred to the physical therapy clinic received a maximum of nine active physical therapy sessions over three weeks which were complemented by a home exercise program. At the end of the three week period, the patients were reassessed and if progress was positive and the prognosis for return to work favourable, a maximum of 20 further sessions over a four week period were scheduled. Patients who did not recover in the allotted period were referred for functional assessment by an occupational therapist or physiotherapist to determine their ability to participate in a multi-disciplinary program. At the multi-disciplinary program, the patients were assessed by a physician and psychologist to confirm the diagnosis, assess obstacles to healing, and determine the degree of residual pain and to propose treatment options. Based on these assessment recommendations, an inter-disciplinary team of physicians, physiotherapists, occupational therapists and psychologists managed the cases where physical therapy alone had not proven effective. This program lasted a maximum of seven weeks. Recovery was defined as patients who had stopped receiving compensation. The rate of ending compensation was significantly higher in the intervention group, while the cost per patient was significantly reduced due to a reduction in the costs associated with salary replacement and physiotherapy. The authors conclude that directing patients through a unified continuum of care reduces their time on compensation and related costs.

The same strategy, although implemented in a workers compensation setting, markedly reduced costs due to reduced temporary and permanent disability compensation
payments and reduced healthcare utilisation (141). Despite being unable to match satisfaction with individual patients, overall satisfaction ratings improved slightly with the continuum of care model. Of those not satisfied, the majority rated the treatment duration as too short. This study demonstrated the importance of correct timing of the multidisciplinary intervention. Extending physiotherapy or chiropractic care beyond the timeframe of the model was associated with a poorer outcome.

These studies show firstly, that frequent visits to health care professionals can lead to the development of illness type behaviour due to patients associating high frequency of medical attention with an increased severity of disease. Therefore, consultations should be outcome based, whereby if an intervention does not achieve an improvement in both objective and subjective outcomes, the treatment should be modified and should to take into account the psychological aspects of the disorder.

2.3. Conclusion

The purpose of this review was to firstly identify the predictors of health outcome following RTCs, and secondly to evaluate the effectiveness of early active management of acute MSK injuries in order to find evidence to support the use of this approach in Australian patients.

A recent systematic review of the literature concluded that early physical activity in acute WAD is recommended (142), a conclusion for which supporting evidence may be found in many of the studies presented here. However, many of the studies had difficulty in demonstrating clear long-term physical health benefits from early active interventions. In
general, objective physical outcomes such as range of motion were not significantly improved following early active intervention. A potential explanation for this lies in two factors identified as limitations in several of the studies reported in this review; namely, poor compliance and use of co-interventions. Poor compliance is a problem in outpatient studies, especially in those requiring adherence to a home-based exercise or treatment programme. In the study by Soderlund et al. (2000) (100), only 41 percent of patients complied with the prescribed exercise programme. Compliance is further complicated when interventions are multifaceted. A number of studies incorporate several aspects to the treatment plan and it is difficult to determine whether patients comply with some aspects of the intervention and not with others. If early active intervention is effective, lack of compliance with an aspect of the treatment plan would bias the observed effect to the null, as is the case with several of the studies presented in this review.

The use of co-interventions is also a particular problem with outpatient studies, which weakens the validity of the data presented. For example, it is notoriously difficult to control the type of care that patients receive outside of the study in which they are enrolled. The treatment and advice received may be inconsistent or at worst contradict that being evaluated in the study.

Although early active interventions failed to show consistent improvement in physical function, improvement in subjective outcomes such as perception of neck pain and headache were more consistent across the studies. There are several possibilities that may explain this finding, all of which relate to behavioural or psychological factors that influence pain perception. MSK pain is exacerbated by behavioural adaptations such as
protective posturing, pain avoidance and kinesiophobia (143). This can lead to a cycle of physical deconditioning, neural hypersensitivity and potentiation of the pain syndrome (144). Much of this maladaptive behaviour is based on the patient’s inaccurate perceptions of the severity and prognosis of their injury.

Stress and anxiety have also been shown to predict the occurrence and outcome of neck and back pain (23, 65, 67, 80, 145, 146). Providing patients with reassurance and a realistic understanding of their injury severity may give them confidence to self-manage and reduce their fear and anxiety in relation to their injury. Studies have shown that active coping styles and self-efficacy are associated with improved outcomes following RTCs (99-101).

If we consider the injured person in the early post-crash period, they are likely to be in an anxious, emotional and vulnerable psychological state. In such patients, the manner in which the physical injury is assessed and treated becomes an important factor and may explain some of the differences seen in evaluations of early intervention strategies, particularly in strategies which focus on the physical aspects of injury management and where only physical or functional outcomes are assessed. This is further supported by the positive results observed in studies that implemented some form of treatment targeted toward improving the psychological wellbeing and coping of the patient.

Another aspect of early active intervention that is likely to have a positive effect on pain and pain associated disability, is time spent with the health care professional and the effective explanation of the injury and development of a treatment plan as well as physical treatments performed. This interaction with the health care professional may
legitimise the patient’s injuries, reduce their anxiety and improve their self-efficacy, and thus result in a favourable improvement in functional and physical health. Having stated this, the frequency of visits with health care professionals must be managed appropriately, as high frequency visits have been shown to be detrimental to outcome (137), potentially as a result of reinforcing the patient’s anxiety about the severity and prognosis of their injuries.

It is still unclear as to what drives the positive outcomes attributed to early active intervention in some studies. Evidence is inconclusive on the precise timing and the individual components of the model that delivers the most effective approach. However, the most appropriate period in which to guide patients down an active treatment pathway, and thereby avoid progression to chronic injury, would appear to be in the first few weeks after injury. In conclusion, early, active, multidisciplinary management can improve the outcome of MSK injuries caused by RTCs, if the psychological aspects associated with the injuries are addressed in conjunction with management of physical injuries of the patient.
Chapter 3. Methods

This thesis seeks to understand how people recover from mild to moderate musculoskeletal (MSK) injuries following road traffic crashes (RTC). This chapter describes the methods pertaining to the studies presented in chapters 4, 5, and 6. Study design, participant demographics, recruitment and consent, outcome measures, data collection, sample size and intervention will be discussed here. Statistical methods, although outlined in this chapter, are discussed in depth in subsequent chapters.

3.1. Study design

The design was an intervention study using an historical control group. It could also be termed a sequential, cohort intervention study involving the recruitment of a control group of 95 participants followed by an intervention group of a similar number. The control group provided a baseline group reflecting the standard of care normally available to residents of the Australian Capital Territory (ACT) following a RTC at that time.

3.2. Study population

The study population consisted of adults (aged 18 -70 years) presenting to the Emergency Department (ED) of the public hospitals in the ACT following a RTC. Participants were recruited from September 2006 to May 2008 from the EDs of Canberra Hospital and Calvary Hospital. In the ACT, all trauma cases requiring public hospital admission are
treated at Canberra Hospital. Calvary Hospital does not provide trauma services, however minor crashes in the northern region of the ACT are typically seen in the Calvary ED.

3.3. Inclusion and exclusion criteria

Inclusion criteria included: people attending the ED with a mild to moderate MSK injury or uncomplicated long bone fracture following a RTC in the previous seven days; aged 18-70 years; and usually resident in the ACT. Crashes could have occurred outside the ACT, but participants needed to live in the ACT and to present to either of the participating hospitals for inclusion.

Patients who met any of the following criteria were excluded: inpatient for more than three days; brain or spinal cord injury; crash occurred during work; unable to speak or read English; did not wait to be seen by a doctor in the ED; pregnant; pedestrians; and patients considered not suitable for a home visit e.g. known illegal drug users or those where a psychiatric condition was noted in the history.

The ED admissions register at each participating hospital was checked on a daily basis and patients that met the inclusion criteria were identified. Patients were then contacted via telephone and invited to participate in the study. Patients that were not able to be contacted or were not available to provide baseline data within four weeks of their crash were excluded. Patients who consented to participate in the study were interviewed at their home, workplace or in the research office in order to complete the baseline data questionnaire.
Initially, only people who had been involved in a motor vehicle crash were included in the study. Ethics approval for motorcycle crash inclusion was sought and recruitment began in January 2007. Initially it was felt that injuries sustained by this group were too serious for inclusion but a screening log kept during the early phase of recruitment revealed that 50% of motorcycle crash presentations to the Canberra Hospital ED met the study criteria.

3.4. Recruitment of participants

The recruitment of study patients occurred in two phases: control group of 95 patients from September 2006 to July 2007; intervention group of 98 patients from August 2007 to May 2008.

At Canberra Hospital patients were identified from the ED admission lists. A daily report was provided of patients presenting to the ED that were aged between 18-70 years and were resident in the ACT. Those who did not wait to be seen were excluded. The Research Coordinator also screened the ED admission notes on a daily basis to ensure that patients weren’t missed. Study staff contacted eligible patients via telephone. Contact details were obtained from the admission notes.

At Calvary Hospital, recruitment commenced three months after Canberra Hospital due to delayed approval from Calvary Hospital Human Research and Ethics Committee (HREC). Calvary Hospital was unable to provide daily admission reports similar to those at Canberra Hospital, and HREC approval was not granted for study staff to contact patients directly. Instead, study staff were only able to contact patients who had given prior consent to being contacted. The responsibility for this prior assent lay with the doctors.
and nurses of the ED. This resulted in only 15 percent of eligible patients being available to study staff.

An approach was made to the Calvary Hospital HREC five months after recruitment had commenced to argue for a changed approach to the recruiting methodology whereby all patients could be approached. Following negotiation with the Committee, the appointment of the research staff to an honorary research affiliate position at the hospital was achieved. The creation of the research affiliate position enabled a nominated research team member to review the ED daily admission register and to review patient ED notes. Recruitment consistent with the method in use at Canberra Hospital commenced six months later.

Several steps were taken to improve patient recruitment prior to and during the study. Information sessions were provided by the study staff to the ED medical, nursing and clerical personnel throughout recruitment. Study information posters were on display throughout the two participating institutions. These, along with a more detailed study information brochure were positioned in the ED and X-ray department waiting rooms, and the hospital foyers. The poster and brochures are shown in Appendix A (Sample 7-9).

Patient contact details were sought from the ED medical record. Direct phone contact with the potential recruit was required in order to discuss participation in the study. Messages on voicemails, answering services or via third parties were avoided due to privacy issues. Attempts were made to contact people during normal business hours, after hours and on weekends. If no contact was made after a reasonable length of time and several attempts, the person was deemed “unable to be contacted”. It was not
unusual for the hospital patient records to have incorrect contact details. In these instances, attempts were made to gather correct details from the online White Pages.

Most participants left hospital within 24 hours of presentation and were contacted by the research coordinator within one or two days following discharge. For those patients who indicated they were willing to participate in the study, a meeting was arranged either at the patient’s home or in a place of mutual convenience, for the purpose of obtaining informed consent. During the intervention phase of the study, participants were able to complete the consent and questionnaire data in the Accident Care Evaluation (ACE) clinic, prior to their specialist assessment appointment.

At the start of recruitment (September 2006) research staff attempted to contact patients within 24 hours of discharge to invite them to participate in the study. While doing this, research staff observed that patients contacted 24-36 hours post-discharge often did not consider themselves as injured enough to participate in the study. However, where patients were unable to be contacted within 24 hours and follow-up occurred between 48-72 hours post discharge, both the incidence of injury reporting and willingness to participate in the study increased. This led the research staff to believe that the full extent of injury post-crash may not become apparent to most people until 48 or more hours post-crash. For this reason the study methodology was altered so that initial follow-up post-crash occurred at 48 or more hours post-crash rather than 24 hours post-crash.

When telephone contact was made, potential recruits were invited to participate in a research study that sought to understand how people recovered from RTCs over a 12-month period. In addition, those recruited to the intervention group were told that the
study was trying to evaluate if a difference could be made to a person's recovery if they were assessed early by a MSK physician. Potential participants were also told that the aim of this specialist assessment would enable a detailed understanding of what injuries had been sustained and include the development of a treatment plan. This treatment plan had the potential to include further radiological assessment, referral to a physiotherapist or other health professional, or a home exercise programme. The focus of the treatment programme was on understanding the injury, determining the expectations for pain and recovery and providing the person with information about appropriate treatments. It was explained that the key to the treatment was the specialist assessment. The patient was told that their local GP would be advised of the visit to the clinic and the treatment plan would be copied to them unless the participant indicated otherwise.

Additionally, all participants were advised that an economic evaluation of the study would be performed. It was explained to participants that the purpose of the economic component of the study was to try and understand the true costs of injuries following RTCs. Costs were to be gathered from associated institutions including: ACT Health; Medicare Australia; private health insurers; and the compulsory third party (CTP) insurer. Participants were told that the study could only access health and economic data that was specifically related to their crash. The study staff would not have access to any other medical information from any of the associated institutions. Additionally, no information about the participant's crash, aside from the date of the incident would be released to the associated institutions. Participants could opt not to be part of the economic evaluation. The economic analysis is outside the scope of this thesis.
3.5. Consent process

All participants were asked to provide written consent to two components of the study. The first component was the clinical arm which required completion of health outcome questionnaires at baseline, six months and 12 months following the participant’s crash. The second component was the economic arm of the study that sought consent to retrieve data for the 12-month period following the crash from the participant’s private health insurer, Medicare Australia, ACT Health and Insurance Australia Group / NRMA Insurance. NRMA Insurance was the sole provider of CTP insurance in the ACT at the time of the study. The economic analysis is outside the scope of this thesis. See Appendix B for consent form.

3.6. Measures

3.6.1. Baseline data

Demographic, crash, injury and compensation data were collected at baseline. See Appendix B for baseline data questionnaire.

3.6.1.1. General demographic and socio-economic factors

Age at the time of crash was measured as a continuous variable and gender was dichotomous.

Marital status was categorised as single, married, separated, divorced, de facto or widow(er).
Number of dependents was categorised as nil, 1, 2, 3 and more than 3. A dependent could be a child or an adult.

Level of education referred to the highest level of education achieved and was first categorised into primary school; secondary school; Technical and Further Education (TAFE)/post secondary college; and tertiary. The variable was later converted to a dichotomous variable which was considered positive if the patient had completed post secondary education.

Occupation was categorised into eight groups using the Australian Standard Classification of Occupations (1997) (147) coding system. This variable was later dichotomised as professional (included occupation groups manager and administrators; professionals; associate professionals); or not.

Work status was categorised into nine groups initially: in paid full-time work; paid part-time work (number of hours/week specified); completely retired/pensioner; partially retired; performing unpaid work; student; home duties; disabled or sick; unemployed. This was converted to a dichotomous variable which was: employed (in paid full-time work; paid part-time work or a student in paid part-time work); or not.

Average yearly income after tax was categorised into ten bands as per the Australian Bureau of Statistics income reporting. This was split into five categories: $0 - $31,199; $31,200 - $67,599; $67,600 - $103,999; ≥$104,000; declined to answer.
Country of birth was dichotomised and expressed as being born in Australia or not.

Language was dichotomised and expressed as language other than English (LOTE) was spoken at home or not.

Home situation was initially categorised into six groups then re-categorised into three groups due to small numbers in some categories. The final categories were: lives alone; lives with spouse/family; lives with flatmate.

3.6.1.2. Crash factors

Date and time of the crash were recorded as reported by the participant.

The number of vehicles involved in the incident was initially recorded as a continuous variable. It was later dichotomised and considered as more than one vehicle involved in the crash, or not.

Direction of impact was categorised into rear, head-on, right hand side, left hand side.

The variable was later described in terms of the mechanism of the impact and categorised as: rear-end crash (regardless of whether the participant’s vehicle was rear-ended or they were the “rear-enddate”); right angle crash (t-bone); head-on crash (two vehicles colliding head-on); side-impact (same or opposite direction side-swipe); struck object crash (e.g. guard rail, tree, animal); or rollover.

Use of a seatbelt was categorised into: yes; no; or not applicable (motorbike rider or pillion).
3.6.1.3. **Injury factors**

Participants were asked to list their injuries and then to identify the injury that was causing them most pain or discomfort. This was noted as the "Primary Injury". All reported injuries/injured body sites were compared with hospital records and coded using the Abbreviated Injury Scale (AIS)(version 1985) (11) by members of the research team experienced in injury coding. Version 1985 of the AIS coding system was used to maintain consistency with the version used by the insurance provider in the ACT. The AIS ranks the severity of injury to one body region on a scale of 1-6, with 1 being a minor injury and 6 being incompatible with life. The first digit of the AIS code refers to the body region. The final digit is the severity of injury.

The AIS code provided two methods of measuring injury severity: Injury Severity Score (ISS) and the Maximum Abbreviated Injury Score (MAIS).

The ISS is calculated using the AIS codes. It is a mathematically derived code number determined by adding the squares of each of the three most severely injured body regions (148). The ISS range is 1-75. In the final analysis ISS was dichotomised into 1 - 3 indicating a minor injury, and $\geq 4$ indicating a moderate injury (149).

The MAIS identifies the highest AIS in patients with multiple injuries. It does not consider the site of injury. The last digit of the AIS injury code reflects injury severity. It uses an ordinal scale where a score of 1 indicates minor injury, through to a score of 6 which indicates maximum injury, incompatible with life. In the final analysis, MAIS was treated as an ordinal variable.
Injuries were a self report and were checked against ED notes and ambulance case slips.

A clinical example of calculation of MAIS and ISS: a patient complaining of neck pain, sternal pain caused by seatbelt, thoracic spine and lumbar back pain would be assigned a score as shown in the following table.

**Table 3-1. Example of injury coding using the Abbreviated Injury Scale and Injury Severity Scale**

<table>
<thead>
<tr>
<th>Injury</th>
<th>Abbreviated Injury Scale (AIS)</th>
<th>Body region per Injury Severity Scale (ISS) classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck pain, no fracture or dislocation</td>
<td>70101.1</td>
<td>Neck</td>
</tr>
<tr>
<td>Soft tissue injury / contusion of chest wall</td>
<td>50101.1</td>
<td>Chest</td>
</tr>
<tr>
<td>Thoracic spine strain, no fracture or dislocation</td>
<td>73101.1</td>
<td>Chest – thoracic spine included in ‘chest’ body region</td>
</tr>
<tr>
<td>Lumbar back strain, no fracture or dislocation</td>
<td>76101.1</td>
<td>Abdominal or pelvic contents – lumbar spine included in the abdominal body region</td>
</tr>
</tbody>
</table>

**MAIS** (maximum AIS) = 1

**ISS** = sum of the squares of the three most severely injured areas = 3 (1+1+1)

3.6.1.4. **Compensation factors**

Five variables were derived to analyse compensation: fault status; compensation claim status; propensity to claim; legal representation; and litigation status.
To assist with determination of compensation status, participants were asked if the crash occurred on their way to or from work, during work, or if the crash was potentially a third party compensation claim. Compensation status was initially categorised into six groups based on compensation and fault status: not compensable; CTP eligible; workers compensation not at fault; workers compensation at fault; public liability or unknown fault status.

3.6.1.4.1. *Fault status*

Fault was defined as any driver who caused the crash, or was largely responsible for the crash. It also included the driver of vehicles where no-one was at fault, for example a collision with wildlife. In accordance with this definition, only those drivers or riders who caused the crash were included in the “at fault” (AF) group. All passengers and pillions, and any driver who was not responsible for the crash were included in the “not at fault” (NAF) group. Fault status was determined through a combination of personal interview, a review of ambulance records and hospital ED notes. Classification of fault status was made by two members of the research team. In the event of disagreement, the final decision was made by a third assessor. Fault status was dichotomised and considered positive if the participant was the driver of the AF vehicle.

3.6.1.4.2. *Compensation claim status*

Compensation claim status was defined as the participant having made a CTP compensation claim by 12 months after injury. At the time of the study, the CTP legislation required injured people to lodge a compensation claim within nine months of a crash. Participants known to have lodged a public liability claim or a workers
compensation claim which later converted to a CTP claim were also included in the
“compensation claim” group. Participants who had lodged a claim were identified through
a review of the CTP insurance database and personal interview.

3.6.1.4.3. Propensity to claim compensation status

The third measure of compensation created, was the propensity to claim compensation.
This was categorised into three groups; those eligible to claim compensation and lodged a
claim; those eligible to claim compensation but did not lodge a claim; and those not
eligible to claim compensation. Eligibility to claim compensation was assessed through a
review of ambulance, medical and ED administrative records and personal interview.
Participants who had lodged a claim were identified through a review of the CTP insurance
database and personal interview.

3.6.1.4.4. Legal representation

Legal representation was a dichotomous variable and considered positive if the participant
had engaged a lawyer. Legal representation was identified through: personal interview (at
enrolment); lawyer initiated correspondence to the research study (throughout the course
of the study); and review of the CTP insurance database at the end of the 12-month
follow-up period.

3.6.1.4.5. Litigation status

Litigated claim was dichotomous and considered positive if the participant’s claim was
being litigated by the insurer. Litigation status was determined at the end of the 12-
month follow-up period through review of the CTP insurance database.
3.6.1.5. Claims data

Participant’s names and crash details were checked against the CTP insurance database at the end of the 12-month follow-up period. The following information was collected for those participants who lodged a CTP claim with the ACT CTP insurer: date of claim lodgement; date of claim settlement; date of claim finalisation; claim type (personal injury, workers compensation recovery claim); legal representation; and litigation status. The number of days from the date of crash to each of these variables was calculated and recorded as a continuous variable. Claims data were collected from the insurer at the end of the 12-month follow-up period.

3.6.1.6. Additional information

During conversation in the screening and consent process, patients revealed information about health service utilisation, crash details, experiences in ED and experience with their insurer and legal provider. These comments were recorded by the research staff in handwritten notes, and used to confirm fault status, type of compensation claim status (workers compensation, public liability, CTP or out of State claim) and the use of General Practitioner (GP) and allied health services. For participants in the intervention group, additional information relating to return to normal activities; use of analgesics; use of allied health services; and adherence to treatment advice was gathered. Further details for this are described in the methods section of Chapter 6 ("Evaluation of an early intervention programme").
3.6.2. Outcome measures

Three health outcome measures were used: Medical Outcomes Study Short Form SF-36 (SF-36) version 2.0 Acute (Australian) (150), Functional Rating Index (FRI) (151) and the Hospital Anxiety and Depression Scale (HADS) (152). These scales were administered at enrolment, six months and 12 months following the crash, each within a window period of four weeks for each time of follow-up.

3.6.2.1. SF-36

The SF-36 Version 2.0 (Acute, Australian) measures health related quality of life across eight dimensions (physical functioning; role physical; bodily pain; general health; vitality; social functioning; role emotional; and mental health). The range for each sub-scale is 0-100, with higher scores indicating a better perceived health status. Physical and mental component scores are summary scores of the eight dimensions and are compared with Australian population norms (153). The scores were calculated by entering the participant’s response for each question into an SPSS dataset and executing an Australian weighted scoring algorithm over the data. The algorithm provided automatic calculation for each score and scale. The automatic calculation algorithm was obtained from the authors of the Australian normative data (153). A summary score is calculated based on standardised population data from Australia in 2006 which has a mean of 50 and a standard deviation of 10. A random sample of ten questionnaires was selected and SF-36 scores were manually calculated separately by two members of the research team and checked for accuracy against the algorithm generated scores. All data checked were found to be accurate.
3.6.2.2. FRI

The FRI combines concepts of the Oswestry Low Back Disability Questionnaire and the Neck Disability Index. The ten items measure both pain and function of the spinal MSK system (151). Items use a 5-point scale ranging from 0 (no pain or full ability to function) to 4 (worst possible pain and/or unable to perform the function at all). Responses are summarised and an index score calculated as follows: (total score/40) x 100%. The range of scores is 0 (no disability) to 100% (severe disability). Total scores were treated as continuous data. The mean total FRI score was categorised into minimal (0-20%); moderate (21-40%); severe (41-60%) and very severe (>61%) disability (151). Pain was measured using the pain intensity sub-scale of the FRI with continuous scores ranging from 0 (no pain) to 4 (worst possible pain).

3.6.2.3. HADS

The HADS is a 14 item scale with two sub-scales; one for measuring depressive symptoms, and one for anxiety related symptoms. Each item has a four level response (scored 0-3). Scores are summed separately and total scores for each component are derived where 0-7 represents normal levels of anxiety or depression; 8-10 represents mild anxiety or depression; 11-14 moderate anxiety or depression; and 15-21 represents severe anxiety or depression. HADS has been found to be a reliable measure of anxiety and depression related symptoms in patients attending outpatient medical clinics (152) and has been used in previous studies investigating MSK injuries (154-157).
3.6.3. Data collection and follow-up

Case report forms (CRF) were mailed in a reply paid envelope to participants two weeks prior to the six-month and 12-month anniversary of their crash. If the questionnaire had not been returned to study staff by the anniversary date, participants were contacted by phone, and confirmation of receipt of the mailed questionnaire was ascertained. Participants were asked to complete the questionnaire and return it in the post. An electronic version of the questionnaire was developed during the latter part of the control group follow-up to try to increase the follow-up rate. Additionally, research staff volunteered to collect the completed questionnaire from participants’ homes or place of work.

3.6.4. Missing data

CRF were checked on receipt for missing data. If any questions had been missed, research staff contacted the participant via phone and obtained a verbal response to missed questions. If the participant was unable to be contacted via phone, missing data were managed according to pre-defined methods.

3.6.4.1. SF-36

Missing data were managed according to the methods of Ware et al. (2000) (150). In instances where at least 50 percent of the items in a scale were answered, the average score for the completed items in the same scale was used. If less than 50 percent of the items in a scale were answered, the items were coded as ‘missing’.
3.6.4.2. FRI

Missing data were managed according to the methods of Feise and Menke (2001) (151).

1. When all 10 items are completed, the FRI score is calculated as follows:
   a. \((\text{Total Score} / 40) \times 100\%\)

2. Missing data
   a. When only nine sections are completed, the FRI is calculated as follows:
      i. \((\text{Total Score} / 36) \times 100\%\)
   b. When only eight sections are completed, the FRI is calculated as follows:
      i. \((\text{Total Score} / 32) \times 100\%\)

3. If a person marked a position between two points on the scale, the distance between the participant response and the scores on either side were measured. The score closest to the participant's marking was recorded.

3.6.4.3. HADS

If a participant did not respond to an item, it was recorded as missing.

If a participant marked two responses for a single question, the more severe response was recorded.

3.7. Data quality audit

All data were entered into Excel spreadsheets by the Research Coordinator and was checked for accuracy by a second member of the research team.
An associate investigator, who did not live in the ACT, visited the study site to perform an independent audit. A random sample of consent forms and participant questionnaires were selected and checked for signatures and dates; verification of these consent forms against the medical record; data security; data validation and accuracy. All consent forms and data checks were found to be accurate.

3.8. Intervention group

The major study intervention was exposure to the ACE treatment programme. This included referral to the ACE clinic which was established in the healthcare district of the ACT. The ACE clinic provided patients with access to a healthcare team including a MSK physician, nurse educator and administrative staff. Participants were then clinically assessed and medical imaging was utilised according to evidence based guidelines. Treatment plans were developed to assist the primary healthcare professionals (GPs) and ancillary healthcare providers in managing the participant’s care. Ancillary healthcare providers included physiotherapists, massage therapists, psychologists, and chiropractors. Assessment and treatment was founded on evidence based guidelines for the management of acute MSK symptoms.

The intervention incorporated an education programme. The objective of the education programme was to disseminate information on evidence based best practice guidelines related to the assessment and management of MSK injuries sustained in RTCs. The programme, delivered by the ACE nurse educator and MSK physician was targeted at people injured in the collision, their treating healthcare professionals and the broader ACT community. Educational materials included current literature reviews, treatment protocol
algorithms, and lecture kits. Topics included clinical assessment, self-management of injury and the compensable environment. Materials and lectures could be accessed via a purpose-built ACE website or in face to face education sessions. A detailed description of the ACE intervention is provided in chapter 6. ACE intervention support and educational materials can be found in Appendix A.

3.9. Sample size calculation

The sample size was calculated to detect a difference of 10 points in the primary outcome measure of Physical Component Score (PCS) on the SF-36. At a power of 90 percent and a 2-tailed significance level of 0.05, and an assumed standard deviation of 10 for each group, 22 participants would be required in each group. Drop-outs were considered to be likely in this study, so the number was increased by 70 percent to 74 in total.

This sample size needed to be increased further to provide sufficient power to address the hypothesis relating to people who have a third party compensation claim. Based on an assumption of 40 percent of people with injury pursuing a compensation claim the total number of participants was increased to 95 in each group or 190 participants in total.

Assuming that approximately 25 percent of people approached will agree to participate in the study, 700 potentially eligible participants in total needed to be identified.
3.10. Statistical analysis

Baseline data were described in terms of means, medians, standard deviations (SD) and interquartile range (IQR) for continuous measures. Categorical data were described as percentages.

Primary outcome measures were screened for normality using the Kolmogorov-Smirnov test and where necessary non-parametric methods of analysis were used (Mann-Whitney U or chi-square test). Differences between baseline and follow-up (six months and 12 months) values were calculated and mean values and 95% confidence intervals (CI) presented for the continuous primary outcome measures. Multiple regression analyses were performed to study the influence of prognostic factors on outcomes. For all comparisons, a P value of 0.05 (2-tailed) was considered to indicate statistical significance.

All data of patients who withdrew from the trial were included until the time of withdrawal.

All data were entered into Microsoft Excel spreadsheets and analysed using SPSS version 17.0.

Statistical analysis methods specific to each study are described in detail in the individual chapters.

3.11. Ethics approvals

HREC approval was granted from the Australian National University, ACT Health, Canberra Hospital, ACT Health Calvary Public Hospital and the University of Sydney. Approval for
the change in protocol to include motorcycles was granted from each of the committees. Approval for the change in recruitment methodology at Calvary Hospital was granted from ACT Health Calvary Public Hospital HREC.

The ACE study was registered with Australian New Zealand Clinical Trials Registry. ACTR Number: ACTRN12608000578303

3.12. Governance

The ACE study was managed functionally through a Project Board, the role of which was to provide appropriate clinical and academic input on operational aspects related to the study.

A Management Advisory Group (MAG) was established to provide the study with broader representation of key stakeholder groups. The primary role of the MAG was to offer advice to the project board, to advise on the study delivery model relative to their constituents, and to offer assistance with matters associated directly with their constituency. The MAG comprised representatives from the following institutions and professional associations: The Australian National University, ACT Road Safety Trust, ACT Health, Australian Medical Association (ACT branch), Australian Orthopaedic Association, Australian Physiotherapy Association, Division of General Practitioners (ACT branch), ACT Law Society, Insurance Australia Group.
Chapter 4. Health status of people with mild to moderate injuries following a road traffic crash

4.1. Introduction

Chapter 2 explored the literature on the epidemiology, predictors of recovery and treatment strategies for minor injuries sustained in road traffic crashes (RTCs). This chapter examines the health characteristics of individuals in a defined cohort immediately following a crash. It analyses the health status of people who present to the Emergency Department (ED) of Canberra Hospital or Calvary Hospital following involvement in a RTC.

This chapter also explores the influence of fault on the health outcomes participants enrolled in the study and contributes to an understanding of whether people involved in a crash that was not their fault have a different health outcome to people involved in a crash that was their fault. The underlying assumption is that feelings of anger and blame, and a sense of injustice associated with the crash, may influence health status immediately post-crash.

Although this study was performed in the Australian Capital Territory (ACT) where the prevailing compensation system was fault-based, this chapter does not examine the influence of a fault-based insurance system on injured people’s health outcomes. Rather, it aims to determine whether fault alone, irrespective of claim status, has any association with health outcomes. In this analysis, fault is defined as any driver who caused the crash,
or was largely responsible for the crash. Using the legal definition of fault, it also includes the driver of vehicles where no-one was at fault, for example, a collision with wildlife.

The health status of people immediately following a RTC is highly relevant in identifying health needs and planning appropriate medical intervention post-crash.

4.2. Study aims and hypotheses

The aim of this study was to report on the physical and psychological health status of people with mild to moderate musculoskeletal (MSK) injuries immediately following a RTC, and to compare the effect of fault on health outcomes.

The primary hypotheses were:

1. Physical health as measured by the SF-36 Physical Component Score (PCS) and function as measured by the Functional Rating Index (FRI) will be worse in people who did not cause the crash (i.e. not at fault) compared to those who did cause the crash (i.e. at fault).

2. Psychological health as measured by the SF-36 Mental Component Score (MCS) and Hospital Anxiety and Depression Scale (HADS) will be worse in people who did not cause the crash (i.e. not at fault) compared to those who did cause the crash (i.e. at fault).

4.3. Methods

Data were collected from people identified from the ED registers at the two public hospitals in the ACT: Canberra Hospital and Calvary Hospital. Participants were invited to
join the study if they presented to the ED with mild to moderate MSK injuries that had been sustained in a motor vehicle or motorcycle crash that had occurred in the previous seven days; were aged between 18 and 70 years; and were usually resident in the ACT. Patients were excluded if they had sustained a head injury or spinal fracture or cord injury; required admission to hospital for more than three days; were not conversant in English; did not wait to be seen for treatment; were pedestrians or were pregnant.

Patients were contacted via telephone within seven days of presentation to the ED and screened for inclusion in the study. Patients who consented to participate in the study were interviewed at their home, workplace or in the research office, and baseline data were collected. Participants completed a questionnaire providing socio-demographic, injury and crash related data. The questionnaire is included as Appendix B. Health status was assessed with the SF-36, the FRI, and the HADS. The scales are also shown in Appendix B. Chapter 3 described the methodology for the study in full.

4.3.1. Definition of Fault

Fault status was defined as a driver who caused the crash, or was largely responsible for the crash. It also included the driver of vehicles where no-one was at fault, for example a collision with wildlife. In accordance with this definition, only those drivers or riders who caused the crash were included in the “at fault” (AF) group. All vehicle and pillion passengers, and any driver who was not responsible for the crash were included in the “not at fault” (NAF) group. Fault status was determined through a combination of personal interview, a review of ambulance records and hospital ED notes. Classification of
fault status was made by two members of the research team. In the event of
disagreement the final decision was made by a third assessor.

4.4. Statistical analysis

All data from the patient questionnaire were coded and entered into an Excel
spreadsheet, then imported and analysed using the statistical analysis package SPSS
version 17.0. Some recoding of variables occurred during the analysis. As Injury Severity
Score (ISS) was positively skewed, it was categorised into two groups: ISS 1-3; and ISS ≥4
for inclusion in generalised linear models.

4.4.1. Descriptive analysis – Group statistics

Descriptive statistics were performed. Continuous variables were summarised using
mean, standard error (SE), median and IQR. Categorical data were summarised using
frequency distributions. Health measures were described in terms of mean, SE, median
and IQR.

The baseline characteristics of two groups were compared: those people AF and those
NAF. For continuous data where normality could be assumed, independent t-tests were
performed. The Mann-Whitney U-test was used to compare skewed continuous data.
Chi-square tests were used for categorical data. Statistical significance was assessed at
the 0.05 level.
4.4.2. **Analysis of health outcomes**

In the event of group imbalances, univariate analysis for each health measure was performed to assess for important associations with outcome. To determine associations with fault, explanatory variables and each health measure were assessed in univariate analyses using the generalised linear model. Variables that had a significance level of 0.1 were considered for inclusion in the final multiple regression model.

Generalised linear regression modelling was subsequently used to assess the effect of fault status on health measures while controlling for confounders. Residual plots of the final models were used to assess linear modelling assumptions. Based upon model estimates, marginal means and standard errors for health outcome (SF-36 PCS and MCS, FRI and HADS) are reported.

4.4.3. **Exploratory analyses**

Interactions with fault status were explored using covariates and factors selected in the model. The effect of gender on health measures was assessed with the generalised linear model. Model estimates are reported. The interaction of fault status and gender was assessed with the multivariable generalised linear model.

Finally, sensitivity analyses were performed using alternative definitions of fault to observe any change in effect of fault on health.
4.5. Results

The results of the study are detailed in this section. Characteristics of the study sample are reported first, followed by demographic features, injury and crash factors. Under each of these headings, the whole cohort descriptive results are reported initially, followed by the sub-group comparative results (AF versus NAF). Following this, the health measures are reported, and again, the whole cohort results are followed by the sub-group comparative results. The physical health measures are reported and are followed by psychological health measures. Finally, two exploratory analyses are reported. The first assesses the effect of gender and fault, and the subsequent interaction of these factors; the second is a sensitivity analysis using different definitions of fault.

4.5.1. Study sample

Between September 2006 and May 2008, 1222 people presented to the EDs of Canberra Hospital and Calvary Hospital following a RTC. Of this group, 541 (44.3%) did not meet the inclusion criteria for this study; 154 (12.6%) declined to participate; 232 (19.0%) were not able to be contacted; and 102 (8.3%) were not asked to participate due to a delay in HREC approval at one site. The final study sample comprised 193 participants. Figure 4-1 shows further details.
Reasons for not meeting the inclusion criteria included: person reported that they were not injured (101, 18.7%); resided outside the ACT (94, 17.4%); was an inpatient for more than three days (93, 17.2%); crash involved a motor-scooter or dirt-bike crash not on a public road (45, 8.3%); person did not wait to be seen in the ED (43, 7.9%); was pregnant (35, 6.5%); and/or had initiated a workers compensation claim (33, 6.1%). People who did not participate in the study were more likely to be male and younger compared to the study cohort. See Table 4-1.
Table 4-1. Comparison of people who consented to participate in the study and those did not.

<table>
<thead>
<tr>
<th>Cohort (n=193)</th>
<th>Unable to contact (n=232)</th>
<th>Declined (n=154)</th>
<th>Permission not granted to contact patient (Hospital B) (n=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age mean(SD)</td>
<td>37.2 (13.92)</td>
<td>32.0** (13.6)</td>
<td>32.3** (12.58)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male n (%)</td>
<td>77 (40)</td>
<td>129 (56*)</td>
<td>76 (49)</td>
</tr>
</tbody>
</table>

*comparison with cohort, p<0.05
**comparison with cohort, p<0.005

4.5.1.1. Demographic Overview

The mean time between crash and recruitment into the study was 9.3 days (SD 5.45) with a range of one to 25 days. Participant characteristics are shown in Table 4-2.

4.5.1.1.1. Whole cohort

The mean age of participants was 37 years (SD 14.0) with a range of 18 to 69 years. Of the 193 participants, 116 (60%) were female; 130 (67%) had post-secondary education; 168 (87%) were in paid employment; and 89 (46%) were in managerial or professional roles.

4.5.1.1.2. Sub-groups – “Not At Fault” and “At Fault”

Of the participants, 136 (71%) were classified as NAF. That is, they were not the driver or rider of the vehicle that caused or was responsible for the crash. There were significantly more females in the NAF group (n= 89 (65%)) compared to males (n=47 (35%)). This difference was significant ($\chi^2 = 6.50$, 1 df, p<0.001). The groups were otherwise similar in terms of general demographic profile.
Table 4-2. Characteristics of people with mild to moderate musculoskeletal injuries sustained in road traffic crashes by fault status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Group n=193</th>
<th>At Fault n=55</th>
<th>Not at Fault n=136</th>
<th>mean diff (SE)</th>
<th>95% CI mean diff</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>37.2 (14.0)</td>
<td>34.7 (14.26)</td>
<td>38.5 (13.77)</td>
<td>-3.8 (2.22)</td>
<td>-8.2 to 0.6</td>
<td>0.090</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>34 (24 - 47)</td>
<td>30 (24 - 43)</td>
<td>38 (27 - 48)</td>
<td></td>
<td></td>
<td>0.063</td>
</tr>
<tr>
<td>range</td>
<td>18 - 69</td>
<td>19 - 69</td>
<td>18 - 69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>116 (60.1)</td>
<td>25 (45.5)</td>
<td>89 (65.4)</td>
<td></td>
<td></td>
<td>0.011</td>
</tr>
<tr>
<td>Male (%)</td>
<td>77 (39.9)</td>
<td>30 (54.5)</td>
<td>47 (34.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single (%)</td>
<td>69 (35.1)</td>
<td>20 (36.4)</td>
<td>47 (34.6)</td>
<td></td>
<td></td>
<td>0.337</td>
</tr>
<tr>
<td>Married (%)</td>
<td>99 (51.8)</td>
<td>25 (45.5)</td>
<td>74 (54.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separated / Divorced (%)</td>
<td>25 (13.1)</td>
<td>10 (18.2)</td>
<td>15 (11.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managers/Prof (%)</td>
<td>89 (46.1)</td>
<td>25 (54.5)</td>
<td>63 (46.3)</td>
<td></td>
<td></td>
<td>0.913</td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In paid employment (%)</td>
<td>168 (87)</td>
<td>47 (85.5)</td>
<td>119 (87.5)</td>
<td></td>
<td></td>
<td>0.704</td>
</tr>
<tr>
<td>Language other than English spoken at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (%)</td>
<td>26 (13.5)</td>
<td>2 (3.6)</td>
<td>24 (17.6)</td>
<td></td>
<td></td>
<td>0.011</td>
</tr>
</tbody>
</table>

\(a\) fault status could not be determined for two subjects

\(b\) Mann-Whitney U-test

\(c\) Fisher’s Exact test

### 4.5.1.2. Crash factors

#### 4.5.1.2.1. Whole cohort

Of the participants, 151 (78%) were involved in crashes between two or more vehicles.

Drivers accounted for 132 (68%) of the cohort, 31 (16%) were motorcycle riders and 30
(16%) were passengers. The speed of crash impact ranged from 10 to 125kph, with a mean (SD) of 57.2 (24.1) kph.

4.5.1.2.2. **Sub-groups**

There were a higher number of motorcycle riders in the AF group (18, 32.7%), compared with the NAF group (13, 9.6%). There were a higher number of crashes that involved two or more vehicles in the NAF group (124, 91.2%), compared with the AF group (25, 45.5%). This difference was significant ($\chi^2 = 47.73$, 1df, $p<0.001$). The groups were otherwise similar in terms of crash profile.

Of the 55 participants who were AF, 30 (54.5%) were involved in single vehicle crashes. Single vehicle crashes resulted from hitting an object (e.g. animal) in 13 (43.3%) crashes; losing control of the vehicle in 13 (43.3%) crashes; and falling asleep while driving in four (13.3%) crashes. See Table 4.3.
Table 4-3. Crash characteristics of people with mild to moderate musculoskeletal injuries sustained in road traffic crashes by fault status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Group n=193</th>
<th>At Fault n=55</th>
<th>Not at Fault n=136</th>
<th>mean diff (SE)</th>
<th>95% CI for mean</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single vehicle (%)</td>
<td>42 (21.8)</td>
<td>30 (54.5)</td>
<td>12 (8.8)</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2 or more vehicles (%)</td>
<td>151 (78.2)</td>
<td>25 (45.5)</td>
<td>124 (91.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Driver (%)</td>
<td>132 (68.4)</td>
<td>37 (67.3)</td>
<td>93 (68.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger/Pillion (%)</td>
<td>30 (15.5)</td>
<td>0 (0.0)</td>
<td>30 (22.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorbike rider (%)</td>
<td>31 (16.1)</td>
<td>18 (32.7)</td>
<td>13 (9.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed of Impact (kph)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>57.2 (24.11)</td>
<td>60.9 (23.62)</td>
<td>55.6 (24.43)</td>
<td>5.3 (4.0)</td>
<td>-2.5 to 13.2</td>
<td>0.180</td>
</tr>
<tr>
<td>median (IQR) range</td>
<td>60 (40 - 75)</td>
<td>60 (45 - 80)</td>
<td>60 (40 - 70)</td>
<td></td>
<td></td>
<td>0.153</td>
</tr>
<tr>
<td>Days from crash to baseline data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>9.3 (5.45)</td>
<td>9.2 (5.35)</td>
<td>9.4 (5.51)</td>
<td>-0.2 (0.87)</td>
<td>-2.0 - 1.6</td>
<td>0.867</td>
</tr>
<tr>
<td>median (IQR) range</td>
<td>8 (5 - 13)</td>
<td>8 (5 - 13)</td>
<td>8 (5 - 13)</td>
<td></td>
<td></td>
<td>0.901</td>
</tr>
</tbody>
</table>

*a fault status could not be determined for two participants

4.5.1.3. Injury Factors

4.5.1.3.1. Whole cohort

Most participants reported pain at more than one body site post-crash, with the mean number of injury sites being 3.2 (SD 1.57). The most common primary site of injury was the neck, reported by 88 (46%) participants. The second most common primary site of injury was the chest (sternum and rib cage), reported by 32 (16.6%) participants; this was followed by the lumbar or thoracic spine (29, 15.0%); upper/lower limb (26, 13.5%); shoulder (14, 7.3%); and head (laceration) (3, 1.6%). The median ISS was 3.0 (IQR 2-4) with a range 1 to 20. The ISS was categorised into minor injury (ISS 1-3) and moderate
injury (ISS>4), with 162 (84%) of the group reporting a minor injury. Using an alternate categorisation of injury severity, minor injury, defined as a Maximum Abbreviated Injury Score (MAIS (11) of 1, was reported by 168 (86.5%) participants.

4.5.1.3.2. Sub-groups – “Not at Fault” and “At Fault”

An injury to the neck was reported by 117 (86%) people in the NAF group compared with 34 (62%) people in the AF group. This difference was significant ($\chi^2$=13.87, 1df, $p<0.001$). The differences continued to be evident when neck and thoracic or lumbar spine injuries were considered together. Neck and back injuries (thoracic or lumbar spine) were reported by 123 (90.4%) of the NAF group compared with 38 (69.1%) of the AF group. This difference was significant ($\chi^2$=13.48, 1df, $p<0.001$). The groups were otherwise similar in terms of injury profile. See Table 4-4 for further details.
Table 4-4. Injury characteristics of people with mild to moderate musculoskeletal injuries sustained in road traffic crashes by fault status\textsuperscript{a}

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Group n=193</th>
<th>At Fault n=55</th>
<th>Not at Fault n=136</th>
<th>mean diff (SE)</th>
<th>95% CI for mean diff</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Injuries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>3.2 (1.56)</td>
<td>3.1 (1.36)</td>
<td>3.32 (1.63)</td>
<td>-0.3 (.25)</td>
<td>-0.8 to -0.2</td>
<td>0.251</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>3 (2 - 4)</td>
<td>3 (2 - 4)</td>
<td>3 (2 - 4)</td>
<td></td>
<td></td>
<td>0.345</td>
</tr>
<tr>
<td>range</td>
<td>1 - 8</td>
<td>0 - 7</td>
<td>1 - 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Severity Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>median (IQR)</td>
<td>3 (2 - 3)</td>
<td>3 (2 - 3)</td>
<td>3 (2 - 3)</td>
<td></td>
<td></td>
<td>0.597</td>
</tr>
<tr>
<td>range</td>
<td>1 - 20</td>
<td>1 - 20</td>
<td>1 - 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Severity Score Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>minor (ISS 1-3)</td>
<td>162 (83.9)</td>
<td>43 (78.2)</td>
<td>117 (86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>moderate (ISS &gt;4)</td>
<td>31 (16.1)</td>
<td>12 (21.8)</td>
<td>19 (14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAIS (Maximum AIS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.266\textsuperscript{c}</td>
</tr>
<tr>
<td>minor (%)</td>
<td>168 (87.0)</td>
<td>45 (83.3)</td>
<td>120 (88.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>moderate (%)</td>
<td>22 (11.5)</td>
<td>7 (13.0)</td>
<td>15 (11.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>serious (%)</td>
<td>3 (1.6)</td>
<td>2 (3.3)</td>
<td>1 (0.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary site of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neck %</td>
<td>88 (45.6)</td>
<td>20 (36.4)</td>
<td>67 (49.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chest %</td>
<td>32 (16.6)</td>
<td>11 (20.0)</td>
<td>20 (14.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>back (thoracic or lumbar spine) %</td>
<td>29 (15.0)</td>
<td>7 (12.7)</td>
<td>22 (16.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>upper / lower limb %</td>
<td>26 (13.5)</td>
<td>9 (16.4)</td>
<td>17 (12.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shoulder %</td>
<td>14 (7.3)</td>
<td>7 (12.7)</td>
<td>7 (5.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>head %</td>
<td>3 (1.1)</td>
<td>0 (0.0)</td>
<td>3 (2.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>abdo / pelvis %</td>
<td>1 (0.5)</td>
<td>1 (1.8)</td>
<td>0 (0.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck as any injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neck injury (%)</td>
<td>152 (78.8)</td>
<td>34 (61.8)</td>
<td>117 (86.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck or back as any injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neck or back injured (%)</td>
<td>162 (83.9)</td>
<td>38 (69.1)</td>
<td>123 (90.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a} fault status could not be determined for two subjects
\textsuperscript{b} Mann-Whitney U-test
\textsuperscript{c} Fisher’s Exact test

Appendix Table C 1 provides a complete table of participant characteristics.
4.5.2. Health outcome measures – Whole cohort

4.5.2.1. Physical health

The mean PCS of the SF-36 was 35.9 (SD 9.03) with a range of 16.4 to 61.6. The mean FRI was 55.5 (SD 21.04) which indicated severe disability. The range of disability was 5.0 – 92.5. A severe or very severe disability as assessed by the FRI was reported by 150 (78%) participants (151). Pain levels reflected “moderate pain” on the FRI pain sub-scale. The mean pain intensity score was 2.0 (SD 0.81) with a range of 0 to 4.

4.5.2.2. Psychological health

The mean MCS of the SF-36 was 32.7 (SD 13.82) with a range of 2.3 to 68.4. The mean anxiety score measured by the HADS was 9.1 (SD 4.55) with a range of 0 to 20. Anxiety symptoms were reported by 60% of participants, with 38% reporting at least moderate anxiety (HADS-a score 11-15) or severe anxiety (HADS-a score 15-21) (158). The mean depression score measured by the HADS was 6.3 (SD4.11) with a range of 0 to 19. The depression score was normal (HADS-d score 0-7) (158) in 64% of participants.

Health outcome measures are shown in Table 4-5.
Table 4-5. Health status of people with mild to moderate musculoskeletal injuries sustained in road traffic crashes soon after injury (mean 9.3 days)

<table>
<thead>
<tr>
<th>Health measure</th>
<th>Total Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=193</td>
</tr>
<tr>
<td>SF-36 Physical Component Score (0-100)</td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>35.9 (9.03)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>25.5 (29.1 – 42.2)</td>
</tr>
<tr>
<td>range</td>
<td>16.4 – 61.6</td>
</tr>
<tr>
<td>SF-36 Mental Component Score (0-100)</td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>32.7 (13.82)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>32.1 (22.8 – 42.9)</td>
</tr>
<tr>
<td>range</td>
<td>2.3 – 68.4</td>
</tr>
<tr>
<td>Functional Rating Index (0-100)</td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>55.5 (21.04)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>57.5 (42.5 – 72.5)</td>
</tr>
<tr>
<td>range</td>
<td>5.0 – 92.5</td>
</tr>
<tr>
<td>Disability grade</td>
<td></td>
</tr>
<tr>
<td>minimal (%)</td>
<td>14 (7.3)</td>
</tr>
<tr>
<td>moderate (%)</td>
<td>29 (15.0)</td>
</tr>
<tr>
<td>severe (%)</td>
<td>64 (33.2)</td>
</tr>
<tr>
<td>very severe (%)</td>
<td>86 (44.6)</td>
</tr>
<tr>
<td>Pain Intensity Score (0-4)</td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>2.0 (.81)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>2 (1 – 2.5)</td>
</tr>
<tr>
<td>range</td>
<td>0 – 4</td>
</tr>
<tr>
<td>Hospital Anxiety and Depression Scale (HADS)</td>
<td></td>
</tr>
<tr>
<td>Anxiety (0-21)</td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>9.1 (4.55)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>9 (5.5 – 12.0)</td>
</tr>
<tr>
<td>range</td>
<td>0 – 20</td>
</tr>
<tr>
<td>Anxiety grades</td>
<td></td>
</tr>
<tr>
<td>normal (0-7) (%)</td>
<td>77 (39.9)</td>
</tr>
<tr>
<td>mild (8-10) (%)</td>
<td>47 (24.4)</td>
</tr>
<tr>
<td>moderate (11-15) (%)</td>
<td>38 (19.7)</td>
</tr>
<tr>
<td>severe (16-21) (%)</td>
<td>31 (16.1)</td>
</tr>
<tr>
<td>Depression (0-21)</td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>6.3 (4.11)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>6 (3 – 9)</td>
</tr>
<tr>
<td>range</td>
<td>0 – 19</td>
</tr>
<tr>
<td>Depression grades</td>
<td></td>
</tr>
<tr>
<td>normal (0-7) (%)</td>
<td>124 (64.2)</td>
</tr>
<tr>
<td>mild (8-10) (%)</td>
<td>37 (19.2)</td>
</tr>
<tr>
<td>moderate (11-15) (%)</td>
<td>26 (13.5)</td>
</tr>
<tr>
<td>severe (16-21) (%)</td>
<td>6 (3.1)</td>
</tr>
</tbody>
</table>
4.5.3. **Health outcome measures – Sub-groups**

To determine the influence of fault on health outcome measures the group was examined based on fault status. Those participants who were AF were compared to those who were NAF. The hypothesis was that those people who were NAF would have poorer physical and psychological health scores, compared to those people who were AF. As group imbalances were observed in gender, site of injury and crash factors, naive means are not reported. Instead, regression analyses (univariate and multiple) were used to control for confounders and model estimates are reported.

4.5.3.1. **Univariate analysis**

Simple regression analysis was performed to identify variables that were associated with physical and psychological health measures. The following variables were entered separately into each model: age; gender; language other than English (LOTE; ISS group; MAIS; number of injury sites; presence of a neck or back injury; and fault status.

4.5.3.1.1. **Physical health**

Greater injury severity group (p<0.001) and MAIS (p<0.001) were associated with worse PCS. Greater injury severity (p=0.002), MAIS (p=0.009) and the number of injury sites (p<0.001) were associated with poorer FRI. Female gender (p=0.002), LOTE (p=0.015) and the number of injury sites (p<0.001) were associated with greater pain intensity. The unadjusted association between explanatory variables and physical health measures are shown in Appendix Table C 2.
4.5.3.1.2. Psychological health

Female gender (p<0.001), LOTE (p<0.001), MAIS (p=0.032), presence of a neck or back injury (p=0.047); number of injury sites (p=0.043) and fault status (p=0.001) were associated with worse MCS. Female gender (p<0.001), LOTE (p<0.001), presence of a neck or back injury (p=0.001) and the number of injury sites (p=0.002) were associated with worse HADS-anxiety (HADS-a). Female gender (p=0.003), LOTE (p=0.006) and the number of injury sites (p=0.008) were associated with worse HADS-depression (HADS-d). The unadjusted association between explanatory variables and psychological health measures are shown in Appendix Table C 3.

4.5.3.2. Multiple regression analysis

Generalised linear regression models were created for continuous outcomes to adjust for differences between groups regarding potential confounding factors on the outcomes. Based on the univariate analyses and clinical relevance the final model used fixed effects of age, gender, LOTE, ISS group, number of injuries and fault status, and the gender by fault status interaction.

4.5.3.3. Fault effect (influence of fault on the whole group)

Regression analyses revealed that while the AF and NAF groups had similar physical health profiles, some aspects of the psychological profile for those NAF were poorer after adjusting for age, gender, injury severity, number of injuries and the gender by fault interaction.
4.5.3.3.1. **Physical Health**

In terms of physical health, there were no significant differences in PCS, FRI or pain intensity between the groups after adjusting for confounders.

4.5.3.3.2. **Psychological health**

In terms of psychological health after adjustment, the mean (SE) MCS for the NAF group of 31.4 (1.47) was poorer compared with the mean (SE) of the AF group (37.3, 1.91). This difference was statistically significant (-5.9 (SE2.11); 95%CI -10.1 to -1.8; p=0.005).

Examination of the SF-36 domains revealed that the adjusted mean (SE) role emotional for the NAF group of 23.4 (2.05) was worse compared with the adjusted mean (SE) of the AF group (32.5, 2.67). This difference was significant (-9.0 (2.95); 95%CI -14.8 to -3.3; p=0.002). The mean (SD) mental health score for the NAF group was 33.60 (12.14) which was significantly lower than the AF group (38.18, 12.39) (-4.6 (1.90); 95%CI 0.7 – 8.4; p=.020). There were no significant differences in any of the other domains (physical or psychological). Figure 4.2 provides further details.

After adjusting, there were no significant differences between the groups with respect to the HADS-a scores or HADS-d scores.

Table 4-6 shows the adjusted mean differences between the fault groups.
Table 4-6. Association of fault and health status measure

<table>
<thead>
<tr>
<th>Health measure</th>
<th>At fault mean (SE)</th>
<th>Not at fault mean (SE)</th>
<th>Difference mean (SE) NAF-AF</th>
<th>95% CI for diff</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS</td>
<td>32.5 (1.22)</td>
<td>34.1 (0.94)</td>
<td>1.6 (1.35)</td>
<td>-1.0 to 4.3</td>
<td>0.221</td>
</tr>
<tr>
<td>FRI b</td>
<td>57.4 (2.91)</td>
<td>60.5 (2.24)</td>
<td>3.1 (3.22)</td>
<td>-3.2 to 9.4</td>
<td>0.331</td>
</tr>
<tr>
<td>Pain b</td>
<td>2.0 (0.11)</td>
<td>2.0 (0.09)</td>
<td>0.8 (0.13)</td>
<td>-0.2 to 0.3</td>
<td>0.549</td>
</tr>
<tr>
<td>MCS a</td>
<td>37.3 (1.91)</td>
<td>31.4 (1.47)</td>
<td>-5.9 (2.11)</td>
<td>-10.1 to 1.8</td>
<td>0.005</td>
</tr>
<tr>
<td>HADS-A b</td>
<td>8.6 (0.64)</td>
<td>9.2 (0.49)</td>
<td>0.7 (0.71)</td>
<td>-0.7 to 2.0</td>
<td>0.350</td>
</tr>
<tr>
<td>HADS-D b</td>
<td>6.2 (0.58)</td>
<td>6.8 (0.44)</td>
<td>0.6 (0.65)</td>
<td>-0.7 to 1.8</td>
<td>0.373</td>
</tr>
</tbody>
</table>

Adjusted for age, gender, ISS (as two categorical groups), number of injuries and gender by fault interaction.

a A negative mean difference indicates the not at fault group had on average a poorer health state
b A positive mean difference indicates the not at fault group had on average a poorer health state

Figure 4.2. SF-36 summary scores and sub-scales by fault status for people with mild to moderate injury following road traffic crash

SF-36 domain level adjusteda mean summary scores and sub-scales by fault status

- Mental Health
- Role emotion
- Social function
- Vitality
- General health
- Bodily pain
- Role physical
- Physical function
- Mental Component Summary score
- Physical Component Summary score

- Not at fault
- At Fault
* p<0.05

a means based on model estimates after adjusting for age, gender, ISS (as 2 categorical groups), number of injuries and gender by fault interaction.
4.5.4. **Exploratory analyses**

Two exploratory analyses were performed. The first assessed the effect of gender and fault, and the subsequent interaction of the two factors. The second exploratory analysis identified if alternative classifications of fault influenced the results.

4.5.4.1. **Gender Effect**

Exploratory analyses for gender effects and possible interactions were performed. Regression analyses revealed no significant differences in physical health status between males and females after adjusting for age, injury severity, number of injury sites, fault and gender by fault interaction. However, regression analyses did reveal significant differences in psychological health status between males and females.

4.5.4.1.1. **Physical health**

In terms of physical health, there were no significant differences in PCS, FRI or pain intensity between the males and females after adjustment.

4.5.4.1.2. **Psychological health**

The adjusted mean (SE) MCS score for females of 30.6 (1.84) was poorer compared with the mean (SE) MCS score for males (38.1, 1.60). This difference was significant (difference -7.5; SE 2.17; 95%CI -11.7 to -3.2; p<0.001). The adjusted mean (SE) anxiety score for females of 10.0 (0.62) was poorer compared with the mean (SE) anxiety score for males (7.8, 0.53). This difference was significant (2.3 (SE 0.73); 95% CI 0.9 to 3.9; p=0.002). The adjusted mean (SE) depression score for females of 7.6 (0.56) was poorer compared with
the mean (SE) anxiety score for males (5.5, 0.49). This difference was significant (2.1 (SE0.66); 95% CI 0.8 to 3.4; p=0.002).

Overall, females had poorer psychological health outcomes than males after adjusting for age, injury severity, fault and gender by fault interaction. The effect of gender was greater than the effect of fault. Table 4-7 shows the adjusted mean differences for gender.

<table>
<thead>
<tr>
<th>Health measure</th>
<th>Male mean (SE)</th>
<th>Female mean (SE)</th>
<th>Difference mean (SE)</th>
<th>95% CI for diff</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>34.0 (1.02)</td>
<td>32.6 (1.17)</td>
<td>-1.4 (1.39)</td>
<td>-4.0 to 1.3</td>
<td>0.318</td>
</tr>
<tr>
<td>FRI&lt;sup&gt;b&lt;/sup&gt;</td>
<td>57.0 (2.43)</td>
<td>60.9 (2.81)</td>
<td>3.9 (3.31)</td>
<td>-2.6 to 10.4</td>
<td>0.244</td>
</tr>
<tr>
<td>Pain</td>
<td>1.9 (0.10)</td>
<td>2.1 (0.11)</td>
<td>0.2 (.13)</td>
<td>-0.01 to 0.5</td>
<td>0.062</td>
</tr>
<tr>
<td>MCS</td>
<td>38.1 (1.60)</td>
<td>30.6 (1.84)</td>
<td>-7.5 (2.17)</td>
<td>-11.7 to -3.2</td>
<td>0.001</td>
</tr>
<tr>
<td>HADS-A</td>
<td>7.8 (0.53)</td>
<td>10.0 (0.62)</td>
<td>2.3 (0.73)</td>
<td>0.85 to 3.7</td>
<td>0.002</td>
</tr>
<tr>
<td>HADS-D</td>
<td>5.5 (0.49)</td>
<td>7.6 (0.56)</td>
<td>2.1 (0.66)</td>
<td>0.8 to 3.4</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*Adjusted for age, ISS (as two categorical groups), number of injuries, fault status and fault by gender interaction
<sup>a</sup> A negative mean difference indicates that females had on average a poorer health state.<sup>b</sup> A positive mean difference indicates that females had on average a poorer health state.

### 4.5.4.2. Gender by fault interaction

Gender by fault status interaction term was introduced into the final model but was not statistically significant for any health measure.

### 4.5.4.3. Sensitivity analyses

The regression models developed above were tested using two alternative definitions of fault.

Alternative Fault Grouping 1:
• AF consisted of AF drivers involved in crashes with two or more vehicles.

• NAF consisted of NAF drivers and passengers plus AF drivers involved in single vehicle crashes.

Alternative Fault Grouping 2:

• AF1 consisted of AF drivers in single vehicle crashes.

• AF2 consisted of AF drivers in crashes involving two or more vehicles.

• NAF group comprised NAF drivers and passengers.

Neither alternative fault definition altered the observed effect. See Table 4-8 and Table 4-9.

<table>
<thead>
<tr>
<th>Health measure</th>
<th>At fault mean (SE)</th>
<th>Not at fault mean (SE)</th>
<th>Difference mean (SE)</th>
<th>95% CI for diff</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS(^a)</td>
<td>34.4 (1.90)</td>
<td>34.2 (1.01)</td>
<td>-0.2 (1.77)</td>
<td>-3.7 to 3.3</td>
<td>0.912</td>
</tr>
<tr>
<td>FRI(^b)</td>
<td>56.0 (4.54)</td>
<td>60.7 (2.42)</td>
<td>4.7 (4.22)</td>
<td>-3.5 to 13.4</td>
<td>0.262</td>
</tr>
<tr>
<td>Pain</td>
<td>2.1 (0.18)</td>
<td>2.1 (0.10)</td>
<td>0.1 (0.16)</td>
<td>-0.3 to 0.3</td>
<td>0.842</td>
</tr>
<tr>
<td>MCS</td>
<td>33.4 (2.96)</td>
<td>33.4 (1.58)</td>
<td>-3.0 (2.76)</td>
<td>-8.4 to 2.4</td>
<td>0.276</td>
</tr>
<tr>
<td>HADS-A</td>
<td>9.8 (0.95)</td>
<td>10.3 (0.51)</td>
<td>0.5 (0.88)</td>
<td>-1.2 to 2.3</td>
<td>0.548</td>
</tr>
<tr>
<td>HADS-D</td>
<td>6.1 (0.90)</td>
<td>7.3 (0.48)</td>
<td>1.0 (0.83)</td>
<td>-0.6 to 2.7</td>
<td>0.221</td>
</tr>
</tbody>
</table>

*Adjusted for age, ISS (as two categorical groups), number of injuries, fault status and fault by gender interaction

\(^a\) A negative mean difference indicates that females had on average a poorer health state

\(^b\) A positive mean difference indicates that females had on average a poorer health state

\(^c\) At Fault = at fault drivers involved in crashes with two or more vehicles

Not at fault = not at fault drivers and passengers, plus at fault drivers involved in single vehicle crashes
<table>
<thead>
<tr>
<th>Health status measure</th>
<th>Fault status</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 PCS^b</td>
<td>At Fault 1</td>
<td>2.3 (1.76)</td>
<td>-1.1 to 5.8</td>
<td>0.185</td>
</tr>
<tr>
<td></td>
<td>At Fault 2</td>
<td>0.2 (1.79)</td>
<td>-3.3 to 3.7</td>
<td>0.900</td>
</tr>
<tr>
<td>FRI^c</td>
<td>At Fault 1</td>
<td>1.3 (4.21)</td>
<td>-7.0 to 9.5</td>
<td>0.765</td>
</tr>
<tr>
<td></td>
<td>At Fault 2</td>
<td>5.0 (4.29)</td>
<td>-3.4 to 13.4</td>
<td>0.247</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>At Fault 1</td>
<td>0.1 (0.16)</td>
<td>-0.3 to 0.4</td>
<td>0.820</td>
</tr>
<tr>
<td></td>
<td>At Fault 2</td>
<td>0.1 (0.17)</td>
<td>-0.3 to 0.4</td>
<td>0.813</td>
</tr>
<tr>
<td>SF-36 MCS^b</td>
<td>At Fault 1</td>
<td>-5.4 (2.72)</td>
<td>-10.8 to -0.1</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>At Fault 2</td>
<td>-4.0 (2.77)</td>
<td>-9.4 to 1.5</td>
<td>0.151</td>
</tr>
<tr>
<td>HADS Anxiety^c</td>
<td>At Fault 1</td>
<td>-1.1 (0.88)</td>
<td>-1.9 to 1.6</td>
<td>0.897</td>
</tr>
<tr>
<td></td>
<td>At Fault 2</td>
<td>0.5 (0.90)</td>
<td>-1.3 to 2.3</td>
<td>0.570</td>
</tr>
<tr>
<td>HADS Depression^d</td>
<td>At Fault 1</td>
<td>-0.7 (0.43)</td>
<td>-1.5 to 0.2</td>
<td>0.742</td>
</tr>
<tr>
<td></td>
<td>At Fault 2</td>
<td>1.0 (0.85)</td>
<td>-0.7 to 2.63</td>
<td>0.252</td>
</tr>
</tbody>
</table>

^a Fixed effects were age, gender, baseline health measure mean score, ISS group, time, Study Group (allocation) status and compensation. Comparator is Not at Fault group.

^b A positive mean difference indicates that the Not at Fault group had, on average, a poorer outcome.

^c A negative difference indicates that the Not at Fault group had, on average, a poorer health outcome.

^d NAF = not at fault drivers and passengers
AF1 = at fault drivers in single vehicle crashes
AF2 = at fault drivers in two or more vehicle crashes
4.6. Discussion

This chapter has explored the health state of participants at an early stage following a RTC and revealed that the cohort was characterised by high levels of anxiety, moderate pain and severe functional disability. This is despite the fact that they generally had minor to moderate soft tissue injuries with no major structural derangement, and no life-threatening impairments. Secondly, the association of fault status on health was explored. The influence of fault was apparent at an early stage following the crash. NAF participants displayed aspects of poorer psychological health than AF participants. This was despite the fact that no difference was found in their measures of physical health (PCS, FRI and pain intensity).

4.6.1. Whole cohort descriptive analysis

The mix of injuries sustained by the whole cohort was typical of those resulting from minor RTCs generally. Specifically, there was a large number of neck injuries reported, with more than 80 percent of the cohort describing an injury to the neck. These findings are expected in this setting as whiplash is the most common injury following RTCs (14, 159, 160). Other soft tissue injuries were to the chest, shoulder and ribs, all of which have been previously reported in this setting (161).

The cohort was characterised by minor to moderate injury severity. Two measures of injury severity were calculated, each generated by the AIS (11). The median ISS, at a score of 3, indicated that most participants had a minor injury. The second measure of injury severity used was the MAIS which indicates the maximum severity of injury, regardless of
the body regions that are injured (11). Again, the MAIS score of 1 confirmed that the group generally had minor injuries. This indicates that regardless of the measure used to determine injury severity, the injuries sustained by the participants were minor.

While the majority of crashes involved at least two vehicles, 22 percent were single vehicle crashes involving an object (e.g. light-pole, road barrier) or an animal (most commonly a kangaroo). The average speed of impact was approximately 60kph. However, there were a number of crashes at ‘high speed’, that is, greater than 80kph. Despite the higher speed, these crashes still resulted in relatively minor injury.

Despite involvement in a minor crash and sustaining minor injury, the cohort was characterised by high levels of anxiety, severe functional disability and moderate pain when assessed soon after injury (mean 9.3 days).

4.6.2. **Sub-group descriptive analysis**

When the cohort was examined based on fault status, group differences were observed. There were a higher number of passengers in the NAF group and while this is expected in a fault based compensation system (passengers are automatically considered NAF) it may have some influence on the results. While it is sometimes suggested that the driver of the vehicle is more likely to have an awareness of the impending crash and therefore be better placed to brace and protect themselves, there is no evidence to support the theory (162). In fact, a recent systematic review of risk factors for injury following crashes found no strong evidence for position in the vehicle influencing either injury severity or long-term outcome for soft tissue injuries (163).
There were a greater number of females in the NAF group, which cannot be explained by an over-representation of female passengers. There is evidence that males are more likely to display risky behaviour and consequently cause crashes (164-167), and this could be a reason for the gender disparity between AF and NAF groups.

Female gender has been associated with poorer recovery following minor injury in a crash (2, 21, 27, 80, 168). Compensation claims data consistently reports that females are more likely to claim compensation and are therefore implicitly NAF (159, 160). The current study showed that females were more likely to report poorer psychological health immediately following the crash; and the effect of gender was greater than the effect of fault. It may be postulated that poorer psychological recovery in the female population contributes to the increased compensation claim rates. However, it may simply be the over-representation of females NAF that contributes to the increased compensation claim rate, given that females have poor psychological recovery rates overall regardless of fault status.

More than 80 percent of participants in the NAF group reported a neck injury, which was significantly more than in the AF group, and this difference remained after adjusting for confounders. While there are undoubtedly physical reasons for the presence of neck pain, it is conceivable that the expectations of people with neck pain following a crash may account for some of the differences observed between the fault groups (36, 98, 169). Another possible explanation for the disparity is that people AF may be less inclined to report neck pain. The physical symptoms, for example neck pain, may be present, but as the symptoms are the result of a wrong-doing (inadvertent or otherwise), the injured
person may be more inclined to disregard the injury. Conversely, the NAF group may be driven by feelings of victimisation and being aggrieved. People who have both an expectation of neck injury following a crash, and who can blame someone else for their pain, may be more likely to report neck pain.

4.6.3.  Health outcomes in whole cohort

In terms of general health measures, significant in these results is the relationship between anxiety levels and disability. High levels of disability at baseline are associated with poorer outcomes (15, 23, 100). Over 75 percent of the cohort reported severe or very severe disability at baseline. There is evidence that fear and anxiety may contribute to disability (93). Given that this cohort exhibited both anxiety and disability early after the crash, it is reasonable to assume that addressing issues of fear and anxiety may reduce disability levels.

Both PCS and MCS were lower (worse) in this cohort than had been previously reported in studies of minor injury following RTCs (136, 170). This may be due to the short period between crash and assessment; patients were recruited within 10 days of their crash. It is also possible that because the participants were recruited directly from the EDs the group may have been more injured than in studies where participants were recruited from GPs or allied health practices. Regardless, the fact that participants reported such poor general health 10 days after a crash is important. The 'minor' injury continues to cause high levels of physical and psychological impairment for a considerable period of time.
The pain levels reported in this study are of concern, given that high baseline pain is associated with poor long-term health outcomes following RTC (1, 30, 41, 53, 60, 62). This implies that strategies to reduce pain levels should be instigated as early as possible following RTC to help reduce the risk of long-term health consequences. This study showed that participants continued to report moderate pain 10 days after their crash which raises questions about the effectiveness of pain management strategies delivered in the ED. In cases of poorly controlled pain, the patient will be less likely to move the injured area. Immobilising the injured area can result in muscle wasting and joint stiffening. This in turn increases the sensitivity of pain receptors and heightens the experience of pain (143, 144). Early, proactive pain management strategies should be employed to help prevent the long-term consequences of immobilisation.

In terms of psychological health of the study participants, MCS was below the Australian population norm (153) and HADS-a was classified as abnormal (158). However, the HADS-d scores were normal. It is not surprising that the HADS-d scores were within the normal range since depressive changes are unlikely to have manifested so soon after a crash. However, as depressive symptoms may well arise from prolonged anxiety states, this highlights the importance of managing anxiety early. Additionally, psychological distress has been reported following RTC (22, 67, 80, 171) and there is a large body of evidence demonstrating that emotional distress contributes to MSK pain (67, 74, 76). This study demonstrates that these psychological morbidities are evident very early post-crash. It is likely that psychological distress following RTC contributes to ongoing MSK symptoms.
4.6.4. Health outcomes in sub-groups

The influence of fault status on health measures revealed some important observations. The association with fault was apparent immediately post-crash. This broadens our understanding of health outcomes in a compensation setting. Those NAF displayed some aspects of poorer psychological health (mental and emotional health) than those AF. This was despite the fact that no difference was found in measures of physical health (PCS, FRI and pain intensity). This suggests that non-physical factors associated with feeling aggrieved at being involved in a crash that was the fault of someone else may have deleterious effects on mental well-being. The results of this study suggest that people respond differently based on whether or not they were responsible for the crash.

Previous studies have investigated the effect of compensation on health and demonstrated that compensation is associated with worse health outcome (1, 19, 43, 79, 107, 110, 112, 113). The theory is that the compensation system itself contributes to the poor outcome. This study, however, suggests that some aspects of poor health are manifest prior to entry into the compensation system.

Non-physical factors such as anger (172, 173) and blame (81, 82, 174, 175) have been shown to influence pain perception. In the RTC setting therefore, it is conceivable that fault status and associated attribution may affect the individual’s symptoms. In this study, fault status did not significantly affect pain or disability. However, people who were NAF demonstrated poorer mental health as measured by the MCS, specifically the SF-36 sub-scales of mental health and role emotional. The role emotional sub-scale assesses whether emotional problems such as depression or anxiety have affected a person’s
ability to perform work or other activities of daily living. The mental health sub-scale assesses general mood or affect. A person scoring at the lowest end of the mental health scale would report feelings of depression and nervousness all of the time; whereas someone scoring in the highest region would indicate feelings of peacefulness, happiness and calmness all of the time (150, 176). Participants who were NAF reported significantly poorer emotional and mental health than those AF, which suggests that they reacted differently to the crash compared to those AF.

There is evidence that stress, distress and anxiety predict occurrence and outcome of neck and back pain (23, 65, 67, 80, 145, 146). The NAF group had poorer MCS scores than the AF group. The NAF group also reported a significantly higher rate of neck and back injuries than the AF group. It is conceivable that these high levels of anxiety contributed to their pain experience. When dealing with pain in the post-crash setting, issues of anxiety need to be considered.

In the post-crash period, an injured person is under significant stress. They have been subjected to the shock and discomfort of the collision, and have to deal with non-physical stresses relating to the crash itself, for example, damage to and/or loss of their motor vehicle, completion of administrative documents for police, negotiation of car and/or personal injury insurance claims, and other non-physical stresses such as having time off work, managing home and carer duties etc. Strategies aimed at addressing some of these modifiable factors such as simplifying the insurance process, and providing alternative methods of transport (e.g. replacement vehicle), may help reduce stress and, therefore, improve the overall health outcomes for the injured person.
The effect of gender on health was stronger than that of fault status. Females reported poorer psychological health than males. The evidence that female gender is associated with greater risk of injury in the crash setting is inconclusive (163). However, in a study of people presenting to EDs following a crash, it was shown that females were more likely to attend EDs than males (177). Given that the current study recruited patients directly from EDs, perhaps the poorer outcome reported for females is related to their tendency to seek health care rather than their injury status. Females with poorer pre-existing psychological health might be more likely to attend the ED. The interaction of fault and gender was not significant. This suggests that the observed differences that were seen in gender status and in fault status were true differences after controlling for possible confounders; and the interaction of those two variables did not play a part in outcome.

4.6.5. General observations

Anxiety and pain are both unpleasant experiences. Health care provision for post-crash individuals should focus on early pain reduction, and alleviating patient anxiety and distress. Careful and thorough early assessment followed by appropriate reassurance may reduce anxiety and give patients confidence to self manage. Previous studies (99-101) have shown that active coping styles and self-efficacy are associated with improved outcomes following RTCs.

Throughout the screening and recruitment period a number of important observations were made which provide potential for a better understanding of the immediate post-crash period and treatment requirements of injured people. In the early stage of recruitment it became evident that attempting to contact people within two days of a
crash frequently resulted in people reporting that they were not injured. Subsequently, a change was made to the timing of initial contact with potential recruits. People were contacted after day-2 post-crash by which time the effects of soft tissue injuries were more apparent to them. This suggests that while the initial ED assessment may give a patient confidence that they have no life-threatening injury, the need for treatment comes some days after the event.

A further observation arising from conversations with participants during the screening and recruitment process related to the way in which people prioritised their health care needs immediately post-crash. The primary concern for people during the first couple of days after the crash was to repair or replace their damaged vehicle. The most immediate problem was not to do with health, but one of an administrative nature involving insurers, police, car dealers and managing the implications of a damaged vehicle. Further support for this observation was found in the reasons people gave for declining to join the study. The most common reason for declining to participate was that they were ‘too busy dealing with the car and insurance’, they had ‘too much else going on’. This suggests that if the goal is to get people back to pre-injury health, consideration should be given to providing assistance dealing with the more practical issues that are facing the injured person and their families.

4.6.6. **Strengths and limitations**

This study is unique in that it describes injured people in the immediate period post RTC. Additionally, it specifically investigates at the influence of fault status on health profile using well validated outcome tools.
Selection bias, from a number of sources, is a potential limitation of this study. Firstly, although the research team made every effort, twenty percent of people screened were uncontactable. Compared to the study cohort, these people were more likely to be younger and male. The research team policy of not leaving messages on voicemail or answering services meant that unless the injured person answered the phone, contact could not be made with them. It is possible that people did not answer phones because they had returned to work (although multiple attempts were made to contact people at various times of the day and over weekends). If people had returned to work it may imply that their injuries were not restricting their ability to perform work duties. This could indicate that a group of less injured people were missed. An alternative reason is that people did not answer the phone because they were finding it difficult to cope; they were in pain and avoided unnecessary phone contact.

Additionally, a further 21 percent of potential recruits either declined to participate (154, 12.6%), or researchers were unable to invite them to participate due to Ethics Committee delays in one hospital site (102, 8.3%). Compared to the study cohort, people in these groups were also more likely to be younger and male. Due to the selection bias the findings of this study may not be generalisable to younger males.

Further, a high number of people were excluded from the study because they lived outside the ACT. More than twenty percent of the people who presented to one of the two hospitals in the ACT actually lived outside the ACT. These people were excluded from the study as the compensation systems differ across state and territory lines. Compensation schemes and legislation differ, particularly in their approach to access to
medical care and access to general damages for pain and suffering. This would have made the influence of compensation difficult to compare.

Finally, people who had initiated, or indicated that they were going to initiate a workers compensation claim were also excluded from the study. The workers compensation systems that cover public and private sector ACT employees differ in their approach to treatments; they are no-fault systems, highly legislated and, therefore, prescriptive in terms of management of injury. No studies have compared outcomes in these two unique schemes in this jurisdiction. This meant that there was uncertainty around whether CTP and workers compensation schemes in the ACT were comparable and whether any observed differences in health outcomes may have been due to the different compensation schemes.

4.6.7. Implications / significance

The cohort was classified as having sustained minor injuries on average. This classification could lead to an under-estimation of how the crash has affected their physical health. It is easy to underestimate how injured and debilitated crash victims are, and the needs they have based on that level of pain and disability. This group was recruited directly from the ED where the primary role is to triage, diagnose, treat and discharge patients with acute and urgent illnesses. The ED is best suited for treating badly injured and ill people. In the crash setting, patients who arrive by ambulance are typically seen very promptly, assessed for major problems and referred for radiology. After initial assessment in the ED, and once major injury has been ruled out, patients are generally discharged home with advice to follow-up with their GP. While injury management information (for example, pain
management and recovery timeframes) is provided in the ED, the amount of information that is absorbed by the patient may be limited. The ED will clear the patient of major trauma but it does not necessarily provide them with the tools they need to treat their injury over the longer-term. Educational materials delivered in the form of video and brochures have been shown to be beneficial in improving outcome following whiplash injuries (124, 125). These cost-effective methods of reinforcing a health message should be considered in the post-ED environment.

4.6.8. Recommendations

Given the high levels of anxiety, and the moderate pain exhibited by the group in the early stage after a crash, treatment strategies should aim to allay fears and anxieties through the provision of detailed, thorough assessment and clear injury management planning and support. While it is comforting for people to know that their injury is not life-threatening, they still need to be confident that they have been assessed thoroughly, and have a clear explanation for the high level of pain they are experiencing. They need to be reassured that their pain does not equate to serious physical injury. Explanations of this nature can be difficult to deliver in the ED environment. The patient, dealing with the shock of a car crash may not be receptive at that time. Additionally, the ED treatment provider, often constrained by time, may not be able to spend the considerable time it takes to deliver this message and provide reassurance. While written instructions may be of some benefit, it is unreasonable to expect a shocked, anxious person experiencing high levels of pain to remember detailed advice provided to them in ED. The pain the patient experiences in the initial hours post-crash is likely to increase over the coming days. As
the pain increases, the patient will need reassurance that there is nothing wrong and nothing has been overlooked. Providing advice about managing pain may also help to return a sense of control to the injured person. This may be particularly helpful for those people whose crash was caused by someone else. The NAF person may already be experiencing feelings associated with being in the wrong place at the wrong time, and the associated lack of control. Providing people with the tools to manage their injury may help return a level of control and order, and assist in a faster recovery. This may best be provided by a follow-up post-crash, community-based health clinic, where further advice and injury management information could be delivered. Additionally, ongoing education and up-skilling of GPs in the management of MSK injury would aid in providing effective post-crash community follow-up.

4.7. Conclusions

In summary, this study showed that the participants were in moderate pain, had severe disability and high levels of anxiety. The NAF group demonstrated more emotional and mental disturbance compared to the AF group, and this difference was obvious from very early post-crash. Treatment strategies should aim to address the early pain and disability while providing appropriate psychological interventions.
Chapter 5. The association of compensation on long-term health status for people with musculoskeletal injuries following road traffic crashes
Statement from co-authors confirming the authorship contribution of the PhD candidate

As co-authors of the paper "The association of compensation on longer term health status for people with musculoskeletal injuries following road traffic crashes: emergency department inception cohort study", we confirm that Susannah Littleton has made the following contributions:

- Contributed to discussions on design of the study
- Recruitment of participants and collection of data
- Analysis and interpretation of data under supervision
- Wrote the first manuscript, and followed through to publication, including proofing and final publication details of the manuscript.

This chapter has been published as:
The association of compensation on longer-term health status for people with musculoskeletal injuries following road traffic crashes: emergency department inception cohort study

Abstract

Objective: To compare the health status of people claiming compensation for injuries sustained in road traffic crashes, with people who do not claim compensation.

Design: Prospective cohort study.

Setting: Australian Capital Territory, Australia and a fault-based common law compensation scheme.

Subjects: People presenting to the emergency department with mild to moderate musculoskeletal injury following RTC.

Main Outcome Measures: Physical Component Score (PCS) and Mental Component Score (MCS) of the Medical Outcomes Study Short-Form 36 Health Survey (SF-36), Hospital Anxiety and Depression Scale (HADS) and the Functional Rating Index (FRI). These measures are recorded immediately post-crash, at six months and 12 months post-crash.

Results: Ninety-five people participated in the study and were enrolled a mean of 8.6 (median 8) days following the crash. Eighty-six percent were followed up to 12 months after injury. Mean age was 37 years, sixty-one percent were female and ninety-one percent were employed at the time of their injury. Thirty-three percent ultimately claimed compensation, and twenty-five percent engaged a lawyer.
There were no major differences in baseline personal characteristics or injury related factors between the groups. As expected, involvement as a passenger and in multiple vehicle crashes, were more frequent in the group claiming compensation.

Over the duration of the study claiming compensation was associated with lower SF-36 PCS (-5.5 (95%CI -8.6 to -2.4), p=0.001), greater HADS Anxiety (1.7 (95%CI 2 to 3.3), p=0.048), and worse FRI (11.2 (95%CI 3.9 to 18.5), p=0.003).

There was a highly significant improvement in health status between baseline and six months after injury, but no further significant change between six and 12 months after injury. There was no difference in rate of improvement between the groups.

Claiming compensation and psychological factors were independent predictors of worse health status at 12 months.

Conclusion: In this study the group claiming compensation had overall worse health status following mild to moderate musculoskeletal (MSK) injuries over the course of the study. There was no difference in rate of improvement between the groups. However, it is not possible to determine whether this negative effect was due to claiming compensation itself or the presence of other unmeasured factors.
5.1. Introduction

In Australia musculoskeletal (MSK) injuries are the most common type of injury people sustained following a road traffic crash (RTC). Over 65,000 injuries are reported each year (14) at a cost of more than $950M. While Whiplash Associated Disorder (WAD) is the most frequently reported set of soft tissue injury following a RTC, injuries to the lower back, shoulder, hip and knee are also common. Some studies report recovery from MSK injury to be relatively rapid with symptoms resolving within 7-10 days (36, 37) while others describe symptoms persisting for several years (178, 179). Recent Australian research showed 50 percent of people sustaining whiplash injuries following a RTC continued to report pain and disability at two years (15). Injured people with poor recovery generate the highest costs and therefore it is essential to understand the factors that lead to chronic symptoms and a poorer prognosis. A number of socio-demographic, physical and psychological factors have been associated with poor recovery including high initial pain intensity (23, 54), depression and anxiety (67, 99), female gender (19, 27), and older age (19, 23). Additionally, evidence suggests that non-clinical factors such as lawyer retention (53, 110) and involvement in the compensation process are predictors of negative outcome for people involved in RTCs (19, 113).

The influence of compensation on outcome after RTCs is particularly contentious because it is not clear whether it is compensation per se that is associated with limited recovery or factors associated with people who claim compensation such as pre-injury health status, or other factors associated with the crash, such as psychological sequelae (1, 40, 180).
This study compares the health status of people who claim compensation (compensation group) to those who did not claim compensation (non-compensation group) for injuries sustained in RTCs. Also considered are other factors associated with health status following crashes.

5.2. **Methods**

5.2.1. **Design and data source**

This inception cohort study prospectively recorded data related to health status and other factors following injury in a RTC. Participants were the control group of the Accident Care Evaluation (ACE) study. The ACE study seeks to improve the health status of people injured in RTCs in the Australian Capital Territory (ACT) using a follow-up clinic and an educational programme. The ACT has a population of 330,000 and approximately 220,000 registered vehicles, and a single provider of compulsory third party insurance. At the time of the study the ACT Compulsory Third Party (CTP) scheme was fault-based, and operated within a framework of minimal legislative restriction of compensation for non economic loss. Regardless of the severity of injury, people who were injured in a RTC that was not their fault had unlimited access to general damages through the common law system.

5.2.2. **Ethics approvals**

Human Research Ethics Committee (HREC) approval was granted from all participating institutions: Australian National University, The University of Sydney, The Canberra Hospital and Calvary Public Hospital. All participants gave written informed consent.
5.2.3. Inclusion and exclusion criteria

Data were collected from people identified from emergency department (ED) registers in the two public hospitals in the ACT. Participants were invited to join the study if they presented to the ED with mild to moderate MSK injuries (Injury Severity Score (ISS) <15) that had been sustained in a motor vehicle or motorcycle crash that had occurred in the last seven days; were aged between 18 and 70 years; and were usually resident in the ACT. Patients were excluded if they had a documented head injury, spinal fracture or cord injury; required admission to hospital for more than three days; were from a non-English speaking background; did not wait to be seen for treatment; were pedestrians; or were pregnant.

At the time of recruitment participants completed a questionnaire providing socio-demographic, injury and crash-related data. Health status was assessed with the Hospital Anxiety and Depression Scale (HADS), and the Medical Outcomes Study Short Form 36 (SF-36) and Functional Rating Index (FRI) instruments. Health measures were assessed post-crash and reflected the post-injury status.

Participants were recruited as soon as feasible following presentation to the ED. This was dependent on making contact with the participant, arranging a face to face interview and obtaining informed consent. Follow-up was by postal questionnaires six and 12 months after injury.

Employment was defined as being in full-time or part-time paid work. Students who performed some type of paid part-time work were also included in this group. Post
secondary education was defined as completion of a tertiary degree or Technical and Further Education (TAFE) or college education. The 1997 Australian Standard of Classification of Occupation (ASCO) (147) classification system was used to define occupational group.

5.2.4. Health status measures

The SF-36 Version 2.0 Acute, (Australia) measures health related quality of life across eight dimensions (physical functioning; role physical; bodily pain; general health; vitality; social functioning; role emotional; and mental health) (150). The range for each sub-scale is 0-100, with higher scores indicating a better perceived health status. Physical and mental component scores are summary scores of the eight dimensions and are compared with Australian norms (153).

The HADS is a 14 item scale with two sub-scales; one for measuring depression and one for anxiety. Each item has a four level response (scored 0-3). Scores are summed separately and total scores for each component are derived where 0-7 represents normal levels of anxiety or depression; 8-10 represents mild anxiety or depression; 11-14 moderate anxiety or depression; and 15-21 represents severe anxiety or depression. HADS has been found to be a reliable measure of anxiety and depression in patients attending outpatient medical clinics (152) and has been used in previous studies investigating MSK injuries (154-157).

The FRI combines concepts of the Oswestry Low Back Disability Questionnaire and the Neck Disability Index (NDI). The ten items measure both pain and function of the spinal
MSK system (151). Items use a 5-point scale ranging from 0 (no pain or full ability to function) to 4 (worst possible pain and/or unable to perform the function at all). Responses are summarised and an index score generated. The range of scores is 0 (no disability) to 100% (severe disability).

5.2.5. Compensation definition

Compensation was defined as the participant known to have made a CTP compensation claim within 12 months of injury, which was the maximum amount of time allowed to initiate a compensation claim in the ACT. Participants known to have lodged a public liability claim or a workers compensation claim which then converted to a CTP claim were also included in the compensation group. Participants who lodged a workers compensation claim were excluded. Claimants were identified through a review of the CTP insurance database and personal interview. Also determined, using similar methods, were the number of participants who engaged a lawyer.

5.2.6. Follow-up data

Participant questionnaires were checked on receipt for missing data. If any question had been missed, research staff contacted the participant via phone and obtained a verbal response to those questions.

5.2.7. Statistical methods

Data were analysed using SPSS version 17.0. Shapiro-Wilk tests were used to determine if the data were normally distributed. Baseline characteristics of the two groups, those that
claimed compensation and those that did not claim compensation were compared. For continuous data where normality could be assumed, independent t-tests were performed. The Mann-Whitney U-test was used to compare skewed continuous data. Chi-squared tests were used for categorical data.

Linear mixed models, which expand the general linear model so that the data are permitted to exhibit correlated and non-constant variability, were used to model the effect of compensation on health status over time. Fixed effects were time, compensation status and time by compensation status interaction. Based upon model estimates, marginal means and standard errors for health outcomes (SF-36 PCS and MCS, FRI and HADS) were reported at baseline, six months and 12 months.

To explore other predictors of health status, linear regression modelling was used to evaluate the independent effect of variables on three outcome measures (mean PCS, MCS and FRI). Variables that were associated with a particular outcome at a significance level of \( p < 0.1 \) in univariate analysis were tested for collinearity. Variables were then entered into a backward multiple linear regression analysis. Residual plots of the final models were used to assess linear modelling assumptions. Statistical significance was assessed at the 0.05 level.

5.3. Results

During the period September 2006 to July 2007, 524 people presented to the ED following a RTC. Of this number, 161 (31%) did not meet the study inclusion criteria; we were
unable to contact 206 (39%) and 62 (12%) declined to join the study. Thus the total
number of participants enrolled in the study was 95.

Of the 206 patients who could not be contacted and invited to participate in the study, 56
percent were male compared with 39 percent males in the cohort (p=0.005). The average
age of those that could not be contacted was 32 years, compared with 37 years in the
cohort (p=0.003). Eighty three (87%) participants completed the six-month questionnaire
and 82 (86%) completed the 12-month questionnaire. There were no significant
differences between the responder and non-responder groups at six or 12 months (data
not shown). There were a larger number of dropouts in the non-compensable group
(17%, 11/64) compared to the compensable group (6%, 2/31) but this difference was not
statistically significant (p= 0.21).

Participants were recruited at a mean of 8.6 (median 8) days following presentation to the
ED. The baseline measures for the health outcome tools were obtained at this point.

The mean age of the cohort was 37 years. Sixty-one percent were female and 91 percent
were employed at the time of their crash. Seventy-eight percent of the group reported
the neck or back as an injury site. Nearly half the group (46%) reported the neck and
shoulder as the primary site of injury (PSI). Chest (20%), back (14%) and upper/lower limbs
(18%) were the PSI in the remainder of the group. The median ISS (11) was 3 (IQR 2-3). At
baseline the mean Pain Intensity Score measured with the FRI was 1.9 (SD 0.84), which on
a 0 to 4 numeric rating scale is ‘moderate pain’ (15).

The participants were further analysed with reference to compensation status, based on
those known to have lodged a compensation claim and those known not to have lodged a
compensation claim. Both groups were comparable for age and gender ratio. The characteristics of each group are shown in Table 5-1.

Overall 33 percent of participants claimed compensation and 25 percent engaged a lawyer. All participants engaging a lawyer also claimed compensation.

There were a higher number of motorcycle riders in the non-compensation group and a higher number of passengers in the compensation group. There were more crashes that involved two or more vehicles in the compensation group. These findings are expected in a fault-based compensation system because at fault drivers and riders are not eligible for compensation. Otherwise the groups were similar in terms of general demographics and injury profile.
Table 5-1. Baseline comparisons between people claiming compensation and those not claiming compensation following a RTC

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Compensation Claim n= 64</th>
<th>Compensation Claim n= 31</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>37 (14.2)</td>
<td>36 (13.4)</td>
<td>0.61</td>
</tr>
<tr>
<td>Female, %</td>
<td>61</td>
<td>61</td>
<td>0.97</td>
</tr>
<tr>
<td>Employed, %</td>
<td>89</td>
<td>94</td>
<td>0.48</td>
</tr>
<tr>
<td>Home situation</td>
<td></td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td>Lives alone %</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lives with spouse and / or family</td>
<td>80</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Lives with other %</td>
<td>13</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Post secondary education %</td>
<td>67</td>
<td>64</td>
<td>0.80</td>
</tr>
<tr>
<td>Occupational Group (managers, professionals, associate professionals)%</td>
<td>52</td>
<td>42</td>
<td>0.38</td>
</tr>
<tr>
<td>Language other then English spoken at home, %</td>
<td>11</td>
<td>19</td>
<td>0.26</td>
</tr>
<tr>
<td>Estimated speed of impact mean kph (SD)</td>
<td>53 (24.2)</td>
<td>57 (25.2)</td>
<td>0.42</td>
</tr>
<tr>
<td>2 or more vehicles involved in crash, %</td>
<td>69</td>
<td>90</td>
<td>0.02</td>
</tr>
<tr>
<td>Position in Vehicle</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Driver, %</td>
<td>66</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Motorcycle rider, %</td>
<td>22</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Passenger %</td>
<td>13</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Injury Severity Score</td>
<td></td>
<td></td>
<td>0.30*</td>
</tr>
<tr>
<td>mean (SD)</td>
<td>2.8 (1.7)</td>
<td>3.3 (2.0)</td>
<td></td>
</tr>
<tr>
<td>median (25(^{th}) – 75(^{th}) percentile)</td>
<td>3 (2-3)</td>
<td>3 (2-4)</td>
<td></td>
</tr>
<tr>
<td>Number of listed injuries (self-report)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>2.8 (1.4)</td>
<td>3.2 (1.5)</td>
<td>0.19</td>
</tr>
<tr>
<td>median (25(^{th}) – 75(^{th}) percentile)</td>
<td>3 (2-4)</td>
<td>3 (2-4)</td>
<td></td>
</tr>
<tr>
<td>Neck or Back injury %</td>
<td>72</td>
<td>90</td>
<td>0.04</td>
</tr>
<tr>
<td>Primary Site of Injury</td>
<td></td>
<td></td>
<td>0.61</td>
</tr>
<tr>
<td>Neck %</td>
<td>41</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Chest %</td>
<td>22</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Upper/Lower limb %</td>
<td>16</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Back %</td>
<td>13</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Shoulder %</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Days from crash to consent mean (SD)</td>
<td>8.7 (5.4)</td>
<td>8.4 (5.6)</td>
<td>0.83</td>
</tr>
</tbody>
</table>

* Mann-Whitney \( U \)-test
The association of compensation and health status at the three time points was analysed and is shown in Table 5-2. The SF-36 PCS was significantly lower in the compensation group (mean difference -5.5, SE 1.58; p 0.001). There was no significant difference in the overall SF-36 MCS. HADS-Anxiety (HADS-a) was marginally significantly worse in the compensation group (mean difference 1.7, SE 0.83; p 0.048). There were no differences in the overall HADS-Depression (HADS-d) scores. The FRI was significantly worse in the compensation group (mean difference 11.2, SE 3.69; p 0.003) as was the pain intensity (mean difference 0.4, SE 0.15; p 0.005).

The changes in health status over time in the groups was analysed and is shown in Table 5-3. There was a highly significant improvement on all health measures between baseline (post-injury) and six months but there was no improvement on any health measure between six and 12 months. The interaction effect of time and compensation status was not significant, indicating that the rate of recovery for each group was the same for the compensation and non-compensation groups.
Table 5-2. Association of claiming compensation and health status measures, using linear mixed model analyses\textsuperscript{a}

<table>
<thead>
<tr>
<th>Health status measure</th>
<th>mean difference\textsuperscript{†} (SE)</th>
<th>95% CI</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 PCS\textsuperscript{a}</td>
<td>-5.5 (1.58)</td>
<td>-8.6 to -2.4</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>SF-36 MCS\textsuperscript{a}</td>
<td>-4.3 (2.32)</td>
<td>-8.9 to .35</td>
<td>0.07</td>
</tr>
<tr>
<td>HADS Anxiety\textsuperscript{b}</td>
<td>1.7 (.83)</td>
<td>.02 to 3.3</td>
<td>0.05</td>
</tr>
<tr>
<td>HADS Depression\textsuperscript{b}</td>
<td>1.3 (.71)</td>
<td>-0.1 to 2.7</td>
<td>0.07</td>
</tr>
<tr>
<td>FRI\textsuperscript{b}</td>
<td>11.2 (3.69)</td>
<td>3.9 to 18.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Pain Intensity\textsuperscript{b}</td>
<td>0.4 (.15)</td>
<td>0.1 to 0.7</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Fixed effects were time, compensation status and time by compensation status interaction

\textsuperscript{†} Mean difference is averaged between the differences at six and twelve months

\textsuperscript{b} A negative mean difference indicates that the group claiming compensation had on average a poorer outcome

\textsuperscript{b} A positive difference indicates that the group claiming compensation had on average a poorer health outcome

Table 5-3. Association of time, measured from baseline to 6 months, and 6 to 12 months after injury, and health status measures, using linear mixed model analyses\textsuperscript{a}

<table>
<thead>
<tr>
<th>Health status measure</th>
<th>Baseline to 6 months</th>
<th>6 months to 12 months</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean difference (SE)</td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td>SF-36 PCS\textsuperscript{a}</td>
<td>11.6 (1.16)</td>
<td>9.4 to 13.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>SF-36 MCS\textsuperscript{a}</td>
<td>11.2 (1.59)</td>
<td>8.0 to 14.3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>HADS - Anxiety\textsuperscript{b}</td>
<td>-2.0 (.48)</td>
<td>-2.9 to -1.1</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>HADS - Depression</td>
<td>-1.9 (.40)</td>
<td>-2.7 to -1.1</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>FRI\textsuperscript{b}</td>
<td>-31.3 (2.70)</td>
<td>-35.7 to -26.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Pain Intensity\textsuperscript{b}</td>
<td>-1.0 (.09)</td>
<td>-1.2 to -0.8</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Fixed effects were time, compensation status and time by compensation status interaction

\textsuperscript{b} A positive mean difference indicates an improvement of health status over time

\textsuperscript{b} A negative mean difference indicates an improvement of health status over time
Table 5-4 shows the marginal mean scores for each health status measure at baseline, six months and 12 months following RTC by compensation status. The consistent difference between the groups indicates that claiming compensation was associated with less favourable scores on all measures at each time point. The largest difference was in the disability score (FRI) which was approximately 50 percent higher in the compensation group at six and 12 months after injury. These changes are shown graphically in Figure 1-1 to 1-3.

Simple linear regression revealed that nine variables had an association (at a p value of <0.1) with lower PCS at 12 months. These, along with age, gender and baseline PCS were included in a backward multiple linear regression model. Variables were removed in order, based on least significance in the model: legal representation; baseline PCS; gender; baseline HADS-d; language other than English (LOTE); initial pain intensity; baseline MCS; speed of impact; and number of injuries. The final model explained 22.3 percent of the variance in PCS at 12 months. Age (β = -0.149; p = 0.036), compensation claim (β = -4.59; p = 0.030) and initial HADS-a score (β = -0.798; p < 0.001) were significant associations. See Table 5-5.
<table>
<thead>
<tr>
<th></th>
<th>No Compensation Claim</th>
<th>Compensation Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean (SE)</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>SF-36 PCS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>37.7 (1.16)</td>
<td>35.4 – 40.0</td>
</tr>
<tr>
<td>6 months</td>
<td>51.1 (1.21)</td>
<td>48.7 – 53.5</td>
</tr>
<tr>
<td>12 months</td>
<td>49.9 (1.27)</td>
<td>47.4 – 52.4</td>
</tr>
<tr>
<td><strong>SF-36 MCS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>34.9 (1.67)</td>
<td>31.6 – 38.2</td>
</tr>
<tr>
<td>6 months</td>
<td>43.3 (1.74)</td>
<td>39.9 – 46.7</td>
</tr>
<tr>
<td>12 months</td>
<td>44.5 (1.81)</td>
<td>40.9 – 48.1</td>
</tr>
<tr>
<td><strong>HADS - Anxiety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>8.5 (.57)</td>
<td>7.4 – 9.6</td>
</tr>
<tr>
<td>6 months</td>
<td>7.0 (.59)</td>
<td>5.9 – 8.2</td>
</tr>
<tr>
<td>12 months</td>
<td>7.3 (.61)</td>
<td>6.1 – 8.5</td>
</tr>
<tr>
<td><strong>HADS - Depression</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>5.7 (.48)</td>
<td>4.8 – 6.7</td>
</tr>
<tr>
<td>6 months</td>
<td>4.1 (.50)</td>
<td>3.1 – 5.0</td>
</tr>
<tr>
<td>12 months</td>
<td>4.2 (.52)</td>
<td>3.2 – 5.2</td>
</tr>
<tr>
<td><strong>FRI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>51.1 (2.55)</td>
<td>46.0 – 56.1</td>
</tr>
<tr>
<td>6 months</td>
<td>20.6 (2.63)</td>
<td>15.4 – 25.8</td>
</tr>
<tr>
<td>12 months</td>
<td>21.1 (2.75)</td>
<td>15.7 – 26.5</td>
</tr>
<tr>
<td><strong>Pain Intensity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>1.8 (.11)</td>
<td>1.6 – 2.0</td>
</tr>
<tr>
<td>6 months</td>
<td>0.8 (.11)</td>
<td>0.5 – 1.0</td>
</tr>
<tr>
<td>12 months</td>
<td>0.8 (.11)</td>
<td>0.6 – 1.0</td>
</tr>
</tbody>
</table>

*Marginal means based upon a linear fixed effect model with time and compensation status as fixed effects*
Figure 5-1. Pattern of recovery as measured by the SF-36 mean Physical Component Score (PCS) by compensation status and compared against Australian norm (153)

Figure 5-2. Pattern of recovery as measured by the SF-36 mean Mental Component Score (MCS) by compensation status and compared against Australian norm (153)

Figure 5-3. Pattern of recovery as measured by the HADS mean Anxiety, and mean Depression, scores by compensation group
Table 5-5. Independent associations with health status at 12 months after injury, as measured by the SF36 and FRI health status measures

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Variable</th>
<th>( \beta ) coefficient</th>
<th>SE</th>
<th>standardised ( \beta )</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 PCS at 12 months</td>
<td>Anxiety (HADS-a)</td>
<td>-0.798</td>
<td>0.21</td>
<td>-0.38</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Compensation claim</td>
<td></td>
<td>-4.59</td>
<td>2.07</td>
<td>-0.23</td>
<td>0.03</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-0.149</td>
<td>0.07</td>
<td>-0.21</td>
<td>0.04</td>
</tr>
<tr>
<td>SF-36 MCS at 12 months</td>
<td>Initial SF-36 MCS</td>
<td>0.303</td>
<td>0.09</td>
<td>0.35</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Legal representation</td>
<td></td>
<td>-6.46</td>
<td>2.85</td>
<td>-0.22</td>
<td>0.03</td>
</tr>
<tr>
<td>Female gender</td>
<td></td>
<td>-5.68</td>
<td>2.66</td>
<td>0.22</td>
<td>0.04</td>
</tr>
<tr>
<td>FRI at 12 months</td>
<td>Anxiety (HADS-a)</td>
<td>1.98</td>
<td>0.46</td>
<td>0.44</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Nine variables had an association (at a \( p \)-value of <0.1) with lower MCS at 12 months.

These, along with age were included in a backward multiple linear regression model.

Variables were removed in order of least significance in the model: compensation status; baseline FRI; baseline HADS-a; baseline HADS-d; age; initial pain intensity; and speed of impact. The final model explained 25.1 percent of the variance in MCS at 12 months.

Female gender (\( \beta = -5.68; p=0.036 \)), retaining a lawyer (\( \beta = -6.46; p=0.026 \)) and MCS at baseline (\( \beta = 0.303; p=0.001 \)) were significant associations.

Ten variables had an association (at a \( p \)-value of <0.1) with higher FRI at 12 months.

These, along with age were included in a backward multiple regression model. Variables were removed in order of least significance in the model: HADS-d; baseline FRI; LOTE; initial pain intensity; compensation status; baseline MCS; number of injuries; age; gender;
and legal representation. The final model explained 18 percent of the variance in FRI at 12 months. Anxiety at baseline ($\beta = 1.98; p<0.001$) was the only significant association.

5.4. Discussion

This study demonstrated that the health status of people who had claimed compensation under a fault-based common law compensation scheme for RTCs was worse than those who had not claimed compensation. Although the compensation group had lower scores, they were lower at all time points, and there was no evidence that being in the compensation group changed the rate of recovery. People who claimed compensation had worse health-related quality of life, and greater disability 12 months after injury, as well as reporting that their health status and disability were worse from a very early stage after injury. The compensation effect on physical health status, as measured by the PCS of the SF36, and disability as measured by the FRI, was greater than the effect on psychological status as assessed by the MCS of the SF36 and the HADS.

The injuries sustained in RTCs have a major adverse effect on health status that lessens substantially in the six months after injury. No further recovery between six and 12 months has been demonstrated in this study. In addition to compensation status, recovery is mediated by personal factors such as age, gender and psychological factors (anxiety and depression). The influence of these factors varies with the measure of health status considered. Engaging a lawyer can be an additional negative factor for recovery.

There are a number of possible reasons as to why people who subsequently claim compensation report worse health status at baseline. A more severe crash is unlikely to be
the explanation based on available data. It is possible that people in the compensable group experienced worse health prior to injury, but this too seems unlikely given the demographic similarities and high levels of employment. We believe that psychological factors associated with the crash such as anger, blame, and a sense of injustice are more likely to explain the baseline differences of worse health status. This has been reported by others (79, 108). It has also been demonstrated that the psychological vulnerability of a patient can effect pain perception (40, 76). Similarly Mayou and Bryant (1996) (32) suggest that psychological factors may play an underestimated role in influencing attitudes towards the pursuit of compensation. It is possible that both baseline pain scores and the tendency to claim compensation may be affected by patient psychological status.

Claiming compensation had a negative association with the physical component of health related quality of life and disability, but not psychological factors. The reasons for this finding are not entirely clear. Despite meticulous inclusion criteria there is a possibility that selection bias may be an explanation given that only 95 of a possible 367 eligible cases agreed to enter the study. We are not able to determine whether the baseline health status of those who entered the study was different to the status of those who were eligible but did not enter the study. Another possible explanation is that the experiences that people have as a result of making a claim, for example consulting a lawyer, have a negative effect on health status due to the creation of disincentives for recovery, and additional psychological distress.
Our study showed that longer term health status was not associated with crash-related factors such as the speed of impact, position in vehicle or number of vehicles involved in the incident. Employment status, level of education and type of occupation were likewise not associated. In this study there was no association between the severity or site of the injury, and recovery. This may be at least in part due to the strict selection criteria for this study where individuals with minor to moderate injuries (ISS less than 15, median ISS for the study 3) were specifically recruited.

At the time of study recruitment, the motor traffic insurance scheme in the ACT, operating under a fault-based system, was unique in the Australian environment as it was minimally legislated and largely relied on common law. The legislation did not provide any incentive for early notification of claim and there were no thresholds for accessing uncapped damages for non economic loss. It has been shown that the structure of the compensation system can positively influence health outcomes for people injured in RTCs (108). Systems that ensure early acceptance of claims by the insurer can facilitate early access to treatment. Similarly, elimination of payments for "pain and suffering" for people with minor injuries has been shown to positively influence health outcome (108). The ACT scheme had neither of these attributes and observed differences in health outcome may be related to this.

There was a difference in the compensation group and non-compensation group in baseline post-injury pain scores but this difference was not large. However, the FRI was substantially worse at baseline in the compensation group. It is unclear why the FRI was worse at baseline and again one must consider whether the groups were different prior to
the crash. It would seem that factors other than injury severity had an effect on both FRI and pain scores at baseline. It is feasible that psychological differences between the two groups accounted for lower physical function (FRI) scores. The HADS-a scores were indeed different between groups at baseline.

Each of the health measures showed similar patterns of recovery over time between the non-compensation and the compensation groups. The SF-36 MCS and the HADS-a were worse at baseline in the compensation group. Both groups had similar scores at six months, suggesting that the compensation group had improved (in terms of psychological parameters) to the point where there was no difference relative to the non-compensation group. Between six and 12 months, however, both the SF-36 MCS and HADS-a had deteriorated. While the deterioration was not marked it is interesting to postulate as to what caused these mental function scores to change. Previous studies implicate the compensation process in poorer health outcomes. The adversarial nature of the common law process focuses each party on optimisation of claim settlement. Ongoing medico-legal assessment can take priority over treatment of injury. It is feasible that repeated medical examinations required for the purpose of litigation have a negative effect on the injured person. Previous studies have demonstrated that the compensation process causes stress and anxiety. This study showed that while the mental function scores deteriorated in the compensation group between six and 12 months, the pain intensity did not worsen. This suggests that it was not the pain intensity which caused the compensation group to have the worse mental function scores at 12 months. These findings are consistent with previous studies that suggest that the claim process itself is a

The SF-36 PCS was similar at baseline between the compensation and non-compensation groups. At six months and 12 months however the SF-36 PCS was worse in the compensation group. As stated above, the pain intensity score is similar at six months and 12 months and therefore pain itself cannot be seen as being responsible for the diminished functional scores at six months and 12 months. Previous studies have demonstrated that compensation status influences functional outcome following RTCs (53, 108, 110). The findings of this study support that observation.

5.4.1. Strengths and limitations

This is a relatively small study and, due to this limitation, there may have been insufficient statistical power to detect some differences between the groups. We were unable to assess pre-injury health and psychological status. These factors ideally would be considered as possible explanatory factors. A further limitation is that it is possible that some people included in the non-compensation group may have lodged a claim in a jurisdiction other than the ACT about which we have no data. As the insurance schemes in neighbouring states are less generous with reference to compensation than the ACT, we believe that they would tend to reduce the strengths of association that we observed.

It is possible that demographic variables for this sample may not be extrapolated to other populations. The ACT is middle class, has higher levels of both employment and education and is a more mobile population than other Australian cities (9). Additionally, the
adversarial nature of the RTC environment may not reflect the schemes outside of the ACT.

Selection bias may be a possible limitation of this study. We were unable to make contact with 39 percent of those people who presented to the ED. This group was typically male and younger in age than those recruited. As a result the findings may not be generalisable to younger males. The reasons for being unable to contact patients included the supply of incorrect telephone numbers and our policy of not leaving messages on peoples' answering services. Although this policy meant a high number of potential participants being excluded, we felt that our recruitment methods had to ensure individuals' privacy.

Strengths of this study are the early collection of baseline data following injury and the high rate of follow-up. There was careful determination of health status at standard times after injury using well validated instruments.

5.5. Conclusion

In summary, individuals who claim for compensation after a RTC have worse health outcomes than those who do not claim compensation over the 12-month period following injury. There is, however, no difference in the rate of improvement between compensable and non-compensable groups. These findings are consistent with previous studies which suggest that individuals involved in the compensation process have poorer health outcomes than those not involved in the compensation process, despite having similar RTC severity.
Chapter 6. Evaluation of an early intervention programme for people with mild to moderate musculoskeletal injuries following a road traffic crash

6.1. Introduction

Chapter 4 examined the health characteristics of individuals immediately following a crash, and explored the influence of fault status on health parameters. It showed that people suffering a minor injury following a car crash displayed moderate pain, had severe disability and high levels of anxiety. Furthermore, people who were not at fault in the crash reported more emotional and mental symptoms compared to people who caused the crash, and this difference was obvious from a very early stage after the crash.

Chapter 5 expanded on the theme of fault by exploring how claiming compensation influenced health state longer-term. It showed differences in health outcomes for people who claimed compensation compared to those who did not claim. The most notable differences were seen in the physical measures. This chapter evaluates a treatment strategy for managing people with minor musculoskeletal (MSK) injury following road traffic crashes (RTCs), both within and outside the compensation environment.

MSK pain is exacerbated by behavioural adaptations such as protective posturing, pain avoidance and kinesiophobia (143). This can lead to a cycle of physical de-conditioning,
hyperalgesia and potentiation of the pain syndrome (144). Some of this maladaptive behaviour is based on the patient’s inaccurate perceptions of severity and prognosis of injury (143). Early intervention following soft tissue injury allows thorough, evidence-based clinical assessment of the patient, and provides them with accurate information regarding their condition. Therefore, early management of expectations and correction of inaccurate belief systems may enable patients to self-manage. The principles of early intervention, early expert assessment and early mobilisation, combined with structured rehabilitation have been applied effectively in the professional sport setting for some years. It is reasonable to consider their application wherever soft tissue injury has occurred.

Early assessment of injury provides the opportunity to guide the patient down an active treatment pathway, thereby trying to avoid a maladaptive pain-dysfunction cycle. Home exercise programmes and early activation have been shown to be superior to passive therapies in returning patients to normal function (100). A recent systematic review concluded that early physical activity in acute Whiplash Associated Disorder (WAD) was recommended (181). Additionally, there was evidence that coordination exercise therapy, or the combination of cognitive behavioural therapy with physical therapy, were effective in the treatment of WAD (142).

The primary aim of this study was to evaluate the effect of an early intervention programme on physical and psychological health for people with MSK injuries following a RTC. The programme comprised assessment by a MSK physician, patient education on
pain management and pain physiology, promotion of self-management, and encouragement of early activity.

The secondary aim was to investigate the influence of the intervention on physical and psychological health in people claiming compensation. Data were analysed in three sub-groups: participants not eligible to claim compensation (not-compensable); participants eligible to claim and claimed compensation (compensation-claim); and participants eligible to claim compensation but did not make a compensation claim (compensation but no claim). These sub-groups were reported because the intervention might have a different effect on at least one of them.

6.2. Study hypotheses

The primary hypothesis was that the provision of a programme that included access to specialist assessment and a treatment coordination clinic leads to improved health outcomes for people injured in RTCs in the Australian Capital Territory (ACT).

Specific hypotheses:

3. The intervention is associated with better physical health over the duration of the study as measured by:
   a. SF-36 Physical Component Score (PCS)
   b. Functional Rating Index (FRI)

4. The intervention is associated with better psychological health over the duration of the study, as measured by:
   a. SF-36 Mental Component Score (MCS)
b. HADS-Anxiety (HADS-a)

c. HADS-Depression (HADS-d)

5. The intervention is associated with better health in people claiming compensation as measured by:

a. SF-36 Physical Component Score (PCS)

b. Functional Rating Index (FRI)

c. SF-36 Mental Component Score (MCS)

d. HADS-Anxiety

e. HADS-Depression

6.3. Methods

The methods have been described in detail in Chapter 3.

6.3.1. Intervention

The major study intervention was exposure to the Accident Care Evaluation (ACE) treatment programme. This included referral to the ACE clinic which was established in the healthcare district of the ACT. The clinic provided patients with access to a healthcare team which included a MSK physician, nurse educator and administrative staff.

Participants were clinically assessed and medical imaging was utilised according to evidence based guidelines. Physical examination was performed with particular emphasis on the presence or otherwise of protective posturing, excessive apprehension or abnormal illness behaviour.
At the initial assessment, patients were provided with a detailed explanation of the nature and likely natural progression of their condition. In most cases this involved an explanation of pain physiology using the aid of a PowerPoint presentation (Appendix A). A treatment plan was discussed and written treatment advice was provided. Where appropriate, a simple, written home-exercise programme was prescribed. The exercise instruction sheets had step-by-step guidelines and digital photographs to assist with exercise recall and technique (Appendix A). The patient was also given written advice about any specific concerns related to protective posturing and the use of medication.

Each participant nominated a general practitioner (GP) or practice as their primary carer. Following each ACE clinic visit a follow-up letter detailing the outcomes of the consultation and recommended treatment plan was sent to the participant’s primary carer. The treatment plans were developed to assist the primary health care professionals and ancillary healthcare providers in managing the participant's care. These external healthcare providers included GPs, physiotherapists, massage therapists, psychologists, and chiropractors. Assessment and treatment was founded on evidence based guidelines for the management of acute MSK symptoms.

If indicated, medical imaging was arranged, followed by further clinical review. In addition, if the ACE clinic physician had concerns about a participant with regard to excessive apprehension, anxiety, protective posturing or abnormal illness behaviour, arrangements were made to review the participant at the ACE clinic, two weeks after the initial consultation. The ACE clinic physician considered referral for specialised psychological support if the patient demonstrated ongoing maladaptive behaviour.
If no clinic follow-up was deemed necessary, the ACE clinic physician made arrangements for the nurse educator to telephone the patient two weeks after the consultation to check that there had been satisfactory clinical progress. The nurse educator asked standardised questions relating to use of analgesics, use of medical services, ongoing symptoms and return to normal activities of daily living. If the patient was making satisfactory clinical progress, encouragement and clarification was provided. Patients were referred to the ACE clinic physician if the nurse educator had concerns about the patient based on the two-week follow-up telephone call. The ACE clinic physician arranged to review the patient at the clinic, or consult with the patient over the telephone.

Three months after the initial consultation, the nurse educator telephoned patients to ensure continued satisfactory progress. Participants were asked the same standardised questions and any concerns were relayed to the ACE clinic physician. Patients were discharged from the clinic at this point if they met the following criteria: (a) no requirement for regular outpatient medical services; (b) no requirement for regular analgesia; (c) resumption of normal daily activities of living; and (d) return to normal work activities. If the patient did not satisfy the criteria for discharge, the ACE clinic physician was notified. The ACE clinic physician assessed the patient via telephone and a further consultation was arranged, if required. Patients requiring ongoing assistance beyond four months were encouraged to remain under the care of their usual medical provider.

Adherence to the ACE treatment programme was assessed at the three-month follow-up phone-call. Participants were asked what treatments they were undergoing and responses were checked against the ACE treatment plan. A participant was considered
not to have adhered to the programme if they were undergoing a treatment that had not been recommended by the clinic, or had not followed through with a clinic referral to allied services (e.g. failed to attend physiotherapy).

The intervention was supported by an education programme. The objective of the education programme was to disseminate information on evidence based guidelines related to the assessment and management of MSK injury sustained in RTCs. The programme, delivered by the ACE nurse educator and ACE clinic physician, was targeted at people injured in the collision, their treating healthcare professionals and the broader ACT community. Patient educational materials included brochures and booklets which provided information on healing, pain, types of MSK injury and area-specific exercises for soft tissue injury following a crash. Materials developed for GPs included literature reviews, treatment protocol algorithms, and lecture kits. Topics included clinical assessment of MSK injuries, self-management of injury and the insurance compensation environment. Materials and lectures could be accessed via the ACE website or in face-to-face education sessions. See Appendix A for full details of the intervention and education programme supporting materials.

6.3.2. **Study design**

The study was a prospective sequential cohort design comprising a control group and an intervention group.
6.3.3. Statistical analysis

All data from the patient questionnaire were coded and entered into an Excel spreadsheet, then imported and analysed using SPSS version 17.0. Some recoding of variables occurred during the analysis.

6.3.3.1. Descriptive analysis – Group statistics

Descriptive statistics were performed and the baseline characteristics of the control and intervention groups were compared. For continuous data where normality could be assumed, independent t-tests were performed. The Mann-Whitney U-test was used to compare skewed continuous data. Chi-square tests were used for categorical data.

Statistical significance was assessed at the 0.05 level.

6.3.3.2. Analysis of health outcomes

Univariate analysis for each health measure was performed to assess for important predictors of outcome. To determine associations between health and the intervention, explanatory variables and each health measure were assessed in univariate analyses using the generalised linear model. Variables that had a significance of 0.1 were considered for inclusion in the final multiple regression model.

Linear mixed models were subsequently used to model the effect of the intervention on health status over time while controlling for confounders. Residual plots of the final models were used to assess linear modelling assumptions. Based upon model estimates,
marginal means and standard errors for health outcomes (SF-36 PCS and MCS, FRI and HADS) are reported at baseline, six months and 12 months for each group.

In order to assess the association with compensation and health, compensation status was subsequently introduced into the regression model. Model estimates are reported.

6.3.3.3. Exploratory analysis

Two exploratory analyses were performed. The first was to identify the influence of compliance to the treatment programme on health. The second was to identify the effect of the intervention on health in participant sub-groups.

6.3.3.3.1. Comparison of adherers to non-adherers

Descriptive statistics were performed and the baseline characteristics of participants who adhered to the programme were compared to those who did not adhere. For continuous data where normality could be assumed, independent t-tests were performed. The Mann-Whitney - test was used to compare skewed continuous data. Chi-square tests were used for categorical data. Statistical significance was assessed at the 0.05 level.

6.3.3.3.2. Effect of the intervention on different grades of disability and anxiety

To identify the effect of the intervention on health in participants with different baseline health, linear mixed models were created using categorisation of baseline HADS-a and FRI. Using the FRI mean score, participants were categorised according to their level of functional disability. The baseline FRI score was categorised into minimal (0-20%); moderate (21-40%); severe (41-60%); and very severe (>61%) disability as per established
cut-offs (151). Linear mixed models were subsequently used to model the effect of the intervention on health status over time while controlling for confounders. Residual plots of the final models were used to assess linear modelling assumptions. The regression model used the fixed effects established in the primary analyses. To determine the influence of the intervention on health, the interaction term of study group and baseline disability category was added to the model.

Using the HADS-a mean score, participants were categorised according to their level of anxiety. Baseline anxiety score was categorised into normal (0-7); mild (8-10); moderate (11-15); and severe (16-21) anxiety, as per established cut-offs (158). Linear mixed models were created as above. To determine the influence of the intervention on health, the interaction term of study group and baseline anxiety grade was added to the model.

6.3.3.4. Sample size calculation

The sample size was calculated to detect a difference of 10 points in the primary outcome measure of PCS on the SF-36. At a power of 90 percent and a two-tailed significance level of 0.05 and an assumed standard deviation of 10 for each group, 22 participants would be required in each group. Drop-outs were considered to be likely in this study, so the number was increased by 70 percent to 74 in total.

This sample size needed to be increased further to provide sufficient power to address the hypothesis relating to people who have a third party compensation claim. Based on an assumption of 40 percent of people with injury pursuing a compensation claim, the total number of participants was increased to 95 in each group, or 190 participants in total.
Assuming that approximately 25 percent of people approached will agree to participate in the study, 700 potentially eligible participants in total needed to be identified.

6.4. Results

The study sample is reported first, followed by study group comparison of baseline characteristics including demographic, injury and crash factors. This is followed by the study group comparison of health measures. Where health measures are reported, physical health measures are reported first, followed by psychological health measures. Results relating to the association of compensation within the study groups follow this section. Finally, exploratory analyses specific to the intervention are reported.

6.4.1. Study sample

This sequential cohort study recruited and followed participants over two independent periods of time. Within-study group comparisons are reported first, followed by between-study group comparisons. Figure 6-1 shows the recruitment and follow-up flow diagram for the control and intervention groups.
6.4.1.1. Recruitment of the control group

During the period September 2006 to July 2007, 524 people presented to the ED following a RTC. Of this number, 161 (31%) did not meet the study inclusion criteria; researchers
were unable to contact 206 (39%); and 62 (12%) declined to join the study. The total number of participants enrolled in the control group was 95.

People who could not be contacted and invited to participate in the study were more likely to be male and younger compared to the Control group. People who declined to participate were significantly younger compared to the control group (See Table 6-1).

<table>
<thead>
<tr>
<th>Control cohort (n=95)</th>
<th>Unable to contact (n=206)</th>
<th>p value*</th>
<th>Declined (n=62)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>36.7 (13.84)</td>
<td>31.6 (13.25)</td>
<td>0.003</td>
<td>31.3 (12.30)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male (%)</td>
<td>37 (39%)</td>
<td>116 (56%)</td>
<td>0.005</td>
<td>33 (53%)</td>
</tr>
</tbody>
</table>

*comparison with Control cohort

6.4.1.2. Follow-up of the control group

The six-month questionnaire was completed by 83 (87%) participants, and 82 (86%) completed the 12-month questionnaire. There were no significant differences between the responder and non-responder groups at six or 12 months (See Table 6-2).

6.4.1.3. Exclusions / Withdrawals from the control group

There were no formal withdrawals from the control group.
<table>
<thead>
<tr>
<th>Variable</th>
<th>6 months</th>
<th>12 months</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Responded n= 83</td>
<td>Did not respond n=12</td>
<td>p</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>37.6 (14.0)</td>
<td>31.0 (12.4)</td>
<td>.13</td>
</tr>
<tr>
<td>Female, %</td>
<td>60</td>
<td>67</td>
<td>.76*</td>
</tr>
<tr>
<td>Employed, %</td>
<td>90</td>
<td>92</td>
<td>1.00*</td>
</tr>
<tr>
<td>Number of injured body sites (self-report), mean (SD)</td>
<td>2.9 (1.4)</td>
<td>3.0 (1.4)</td>
<td>.83</td>
</tr>
<tr>
<td>Lodged a Compensation claim, %</td>
<td>30</td>
<td>50</td>
<td>.20*</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>15</td>
<td>.21*</td>
</tr>
</tbody>
</table>

\* Fishers Exact test

6.4.1.4. Recruitment of the intervention group

During the period August 2007 to May 2008, 698 people presented to the ED following a RTC. Of this number, 418 (60%) did not meet the study inclusion criteria; researchers were unable to contact 90 (13%); and 92 (13%) declined to join the study. The total number of participants enrolled into the intervention group was 98.

There were no differences between people who could not be contacted and invited to participate in the study and the intervention group. Those who declined to participate were significantly younger compared with the intervention group (See Table 6-3).
Table 6-3. Comparison of people who consented to participate in the intervention group and those who did not participate in the study (unmeasured groups).

<table>
<thead>
<tr>
<th></th>
<th>Intervention cohort (n=98)</th>
<th>Unable to contact (n=90)</th>
<th>p value*</th>
<th>Declined (n=92)</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>37.6 (14.05)</td>
<td>34.2 (14.06)</td>
<td>.106</td>
<td>33.1 (12.85)</td>
<td>.023</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male (%)</td>
<td>40 (40.8%)</td>
<td>48 (53.3%)</td>
<td>.086</td>
<td>43 (46.7%)</td>
<td>.411</td>
</tr>
</tbody>
</table>

*comparison with cohort

6.4.1.5. Follow-up of the intervention group

The six-month questionnaire was completed by 84 (86%) participants, and 75 (76%) completed the 12-month questionnaire. Table 6-4 shows the characteristics of responders and non-responders at six and 12 months for the intervention group.

Table 6-4. Characteristics of intervention responder and non-responder at 6 months and 12 months follow-up

<table>
<thead>
<tr>
<th>Variable</th>
<th>6 months Responded n=84</th>
<th>Did not respond n=14</th>
<th>p</th>
<th>12 months Responded n=75</th>
<th>Did not respond n=23</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>37.1 (14.2)</td>
<td>37.1 (14.2)</td>
<td>1.0</td>
<td>39.2 (14.78)</td>
<td>32.7 (10.83)</td>
<td>.05</td>
</tr>
<tr>
<td>Female, %</td>
<td>57</td>
<td>71</td>
<td>.31</td>
<td>57</td>
<td>65</td>
<td>.50</td>
</tr>
<tr>
<td>Employed, %</td>
<td>82</td>
<td>93</td>
<td>.32</td>
<td>81</td>
<td>91</td>
<td>.35 a</td>
</tr>
<tr>
<td>Number of injured body sites (self-report), mean (SD)</td>
<td>3.4 (1.59)</td>
<td>4.2 (1.85)</td>
<td>.10</td>
<td>3.3 (1.53)</td>
<td>4.3 (1.80)</td>
<td>.01</td>
</tr>
<tr>
<td>Lodged a Compensation claim, %</td>
<td>35</td>
<td>64</td>
<td>.03</td>
<td>37</td>
<td>44</td>
<td>.60</td>
</tr>
</tbody>
</table>

Note. Intervention non-responder group contains the three exclusions and four withdrawals.

a Fishers Exact test
6.4.1.6. **Exclusions / withdrawals from the intervention group**

Four participants withdrew their consent between baseline and six-month data collection points. Reasons for withdrawal were lawyer advice (three participants) and personal reasons (one participant). As the reasons for withdrawal could be related to the intervention, analysis was performed on an intention to treat principle. The withdrawals could be considered an outcome of the trial intervention.

Three protocol violations occurred in the intervention group: two participants were involved in a second crash during the follow-up period, and one participant was in prison on remand. These three participants were excluded from the follow-up analysis.

6.4.1.7. **Comparison of control and intervention groups follow-up**

There was a trend to greater non-response in the intervention group (21.1% versus 13.7%), but this was not statistically significant (p=0.18). Non-responders in the intervention group reported a significantly greater number of injured body sites than non-responders in the control group (p=0.037). Additionally, non-responders in the intervention group were more likely to have lodged a compensation claim, compared with the control group (p=0.043). (Table 6-5)
**Table 6-5. Comparison of 12-month non-responders in the control group and 12-month non-responders in the intervention group.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control n=13</th>
<th>Intervention n=20a</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>29.9 (11.33)</td>
<td>33.2 (11.12)</td>
<td>0.418</td>
</tr>
<tr>
<td>Female, %</td>
<td>69.2</td>
<td>75.0</td>
<td>0.716</td>
</tr>
<tr>
<td>Employed, %</td>
<td>84.6</td>
<td>90.0</td>
<td>0.999b</td>
</tr>
<tr>
<td>Number of injured body sites</td>
<td>3.1 (1.50)</td>
<td>4.4 (1.73)</td>
<td>0.037</td>
</tr>
<tr>
<td>(self-report) mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lodged a Compensation claim%</td>
<td>15.4</td>
<td>50.0</td>
<td>0.043b</td>
</tr>
<tr>
<td>Baseline SF-36 PCS, mean (SE)</td>
<td>36.6 (2.46)</td>
<td>34.1 (1.37)</td>
<td>0.341</td>
</tr>
<tr>
<td>Baseline SF-36 MCS, mean (SE)</td>
<td>31.4 (3.03)</td>
<td>28.5 (3.15)</td>
<td>0.557</td>
</tr>
</tbody>
</table>

a Excludes the three protocol violations
b Fishers Exact test

### 6.4.2. Study groups comparative analysis - Baseline characteristics

There were few significant differences in the distribution of study variables between the control and intervention group.

#### 6.4.2.1. General demographics

The mean age of the control group was 37 years (SD 14), compared with 38 years (SD 14) in the intervention group. Of the control group participants, 58 (61%) were female compared with 58 (59%) in the intervention group. The mean time from crash to baseline interview and data collection was 8.6 days (SD 5.47) for the control group, compared with 10.0 days (SD 5.36) for the intervention group. There were no significant differences between the study groups in terms of general demographic details. See Table 6-6.
Table 6-6. Baseline characteristics of study participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control n= 95</th>
<th>Intervention n=98</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>36.7 (13.87)</td>
<td>37.7 (14.17)</td>
<td>-1.0 (2.02)</td>
<td>-5.0 to 3.0</td>
<td>0.625</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>33 (25-45)</td>
<td>36 (24-49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>18 - 69</td>
<td>18 - 69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>58 (61.1)</td>
<td>58 (59.2)</td>
<td></td>
<td></td>
<td>0.883</td>
</tr>
<tr>
<td>Male (%)</td>
<td>37 (38.9)</td>
<td>40 (40.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single (%)</td>
<td>30 (31.6)</td>
<td>39 (39.8)</td>
<td></td>
<td></td>
<td>0.498</td>
</tr>
<tr>
<td>Married/Defacto (%)</td>
<td>52 (54.7)</td>
<td>47 (48)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separated / Divorced (%)</td>
<td>13 (13.7)</td>
<td>12 (12.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of dependents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.574</td>
</tr>
<tr>
<td>Nil (%)</td>
<td>60 (63.2)</td>
<td>62 (63.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (%)</td>
<td>13 (13.7)</td>
<td>14 (14.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (%)</td>
<td>11 (11.6)</td>
<td>16 (16.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 or more (%)</td>
<td>11 (11.6)</td>
<td>6 (6.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Socioeconomic factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.878</td>
</tr>
<tr>
<td>Post Secondary Education (%)</td>
<td>63 (66.3)</td>
<td>67 (68.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managers/Professionals (%)</td>
<td>46 (48.4)</td>
<td>43 (43.9)</td>
<td></td>
<td></td>
<td>0.565</td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.199</td>
</tr>
<tr>
<td>In paid full or part-time work (%)</td>
<td>86 (90.5)</td>
<td>82 (83.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language other than English</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>spoken at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (%)</td>
<td>13 (13.7)</td>
<td>13 (13.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living arrangements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives alone (%)</td>
<td>6 (6.3)</td>
<td>13 (13.3)</td>
<td></td>
<td></td>
<td>0.250</td>
</tr>
<tr>
<td>Lives with spouse / family (%)</td>
<td>79 (83.2)</td>
<td>73 (74.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives with flatmate (%)</td>
<td>10 (10.5)</td>
<td>12 (12.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a Fishers Exact Test

164
6.4.2.2. Injury factors

Participants in the intervention group reported a higher number of injury sites (mean 3.6, SD 1.64) compared with the control group (mean 2.9, SD 1.42). This mean (SE) difference was statistically significant (0.64 (0.22); 95%CI 0.20 – 1.07, p=0.005).

An injury to the neck, thoracic or lumbar spine was reported by 88 (90%) participants in the intervention group, compared with 74 (78%) in the control group. This difference was statistically significant (p=0.031). See Table 6-7

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control N= 95</th>
<th>Intervention n=98</th>
<th>mean diff (SE)</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Injuries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>2.9 (1.44)</td>
<td>3.6 (1.64)</td>
<td>-.6 (.22)</td>
<td>-1.1 to -0.2</td>
<td>0.005</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>3 (2-4)</td>
<td>3 (2-5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>1 - 7</td>
<td>1 - 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Severity Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>3.0 (1.79)</td>
<td>3.0 (2.17)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>median (IQR)</td>
<td>3 (2-3)</td>
<td>3 (2-3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>1 - 11</td>
<td>1 - 20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Severity Score group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor (ISS 1-3) (%)</td>
<td>77 (81.1)</td>
<td>85 (86.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate (ISS &gt;/=4) (%)</td>
<td>18 (18.9)</td>
<td>13 (13.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Abbreviated Injury Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor (%)</td>
<td>80 (84.0)</td>
<td>88 (89.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate (%)</td>
<td>13 (13.8)</td>
<td>9 (9.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious (%)</td>
<td>2 (2.1)</td>
<td>1 (1.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary site of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck (%)</td>
<td>40 (42.1)</td>
<td>48 (49.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest (%)</td>
<td>19 (20.0)</td>
<td>13 (13.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back (%)</td>
<td>14 (14.7)</td>
<td>15 (15.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper/lower limb (%)</td>
<td>15 (15.8)</td>
<td>11 (11.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder (%)</td>
<td>6 (6.3)</td>
<td>8 (8.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (%)</td>
<td>1 (1.1)</td>
<td>3 (3.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck or back injured Yes (%)</td>
<td>74 (77.9)</td>
<td>88 (89.8)</td>
<td></td>
<td></td>
<td>0.031</td>
</tr>
</tbody>
</table>

* Mann-Whitney U-test; * Fishers Exact test


6.4.2.3. Crash factors

There were no significant differences between the groups in terms of crash characteristics. The number of vehicles involved in the crash, the speed of impact and position in the vehicle was similar for each group. See Table 6-8.

<table>
<thead>
<tr>
<th>Table 6-8. Crash characteristics of study participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Number of vehicles</td>
</tr>
<tr>
<td>Single vehicle (%)</td>
</tr>
<tr>
<td>2 or more vehicles (%)</td>
</tr>
<tr>
<td>Driver status</td>
</tr>
<tr>
<td>Driver (%)</td>
</tr>
<tr>
<td>Passenger/Pillion (%)</td>
</tr>
<tr>
<td>Motorbike rider (%)</td>
</tr>
<tr>
<td>Speed of Impact</td>
</tr>
<tr>
<td>mean (SD)</td>
</tr>
<tr>
<td>median (IQR)</td>
</tr>
<tr>
<td>range</td>
</tr>
</tbody>
</table>

a Mann-Whitney U test

6.4.2.4. Compensation factors

There were no significant differences in fault status, compensation status or legal representation between the groups. Of the control group participants 64 (68.8%) were not at fault, compared with 72 (73.5%) in the intervention group. A compensation claim was made by 31 (33.3%) of the control group participants compared with 38 (38.8%) of the intervention group. A lawyer was engaged by 24 (25.3%) of the control group compared with 30 (30.6%) of the intervention group. See Table 6-9 for further details.
Table 6-9. Compensation characteristics of study participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Intervention</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N= 95</td>
<td>n=98</td>
<td></td>
</tr>
<tr>
<td>Fault status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At fault (%)</td>
<td>29 (31.2)</td>
<td>26 (26.5)</td>
<td>0.524</td>
</tr>
<tr>
<td>Not at fault (%)</td>
<td>64 (68.8)</td>
<td>72 (73.5)</td>
<td></td>
</tr>
<tr>
<td>Compensation status</td>
<td></td>
<td></td>
<td>0.684</td>
</tr>
<tr>
<td>Not compensable (%)</td>
<td>29 (31.2)</td>
<td>26 (26.5)</td>
<td></td>
</tr>
<tr>
<td>Compensable and Claimed (%)</td>
<td>31 (33.3)</td>
<td>38 (38.8)</td>
<td></td>
</tr>
<tr>
<td>Compensable and NOT Claimed (%)</td>
<td>33 (35.5)</td>
<td>34 (34.7)</td>
<td></td>
</tr>
<tr>
<td>Legal representation</td>
<td></td>
<td></td>
<td>0.408</td>
</tr>
<tr>
<td>Engaged a lawyer (%)</td>
<td>24 (25.3)</td>
<td>30 (30.6)</td>
<td></td>
</tr>
<tr>
<td>Days from crash to baseline data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>8.6 (5.47)</td>
<td>10.0 (5.36)</td>
<td>0.081</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>8 (4-13)</td>
<td>9 (6-13)</td>
<td></td>
</tr>
<tr>
<td>range</td>
<td>1 - 22</td>
<td>3 – 25</td>
<td></td>
</tr>
</tbody>
</table>

See Appendix Table C 4 for complete table of participant characteristics.

6.4.2.5. Clinic Intervention

Each of the 98 participants in the intervention group was assessed at the ACE clinic. The initial consultation was 60 minutes in duration. A single follow-up appointment for clinician review was required by 23 (24.2%) participants, and seven (7.3%) required more than one follow-up appointment. Follow-up appointments were 15 minutes duration. Of the participants, 36 (37.9%) required telephone contact for consultation with the clinic physician, either for results of radiology reports or to seek further advice. Telephone conversations typically took less than 10 minutes. The nurse educator contacted each participant on a mean of 2.0 (SE 0.07; range 1-4) occasions, with 33 calls resulting in medical review. Clinic consultations are shown in Table 6-10.
Of the participants, 48 (50.5%) were referred to radiology or allied health services. Of those 48 participants, 22 (45.8%) required referral to between two and four services. There were a total of 78 referrals; the most common referral was for physiotherapy (28; 35.9%); followed by radiology (19; 24.3%); and pain management (12; 15.4%). Pain management included corticosteroid injection (2; 2.7%) and prescription analgesia (10; 12.8%). Referrals were initiated by the ACE clinic in 18 (23.1%) cases; the ED or participant’s GP in 27 (34.6%) cases; self-referral in 13 (16.7%) cases; and the insurer, or at the direction of the participant’s lawyer, in 8 (10.1%) cases. Of these referrals, 30 (38.5%) were inconsistent with the ACE programme treatment plan. See Table 6-11 for further details.

<table>
<thead>
<tr>
<th>Table 6-10. Clinic experience for intervention group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of intervention</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Physician appointments</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>Physician telephone consultations</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>Nurse Educator contact</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

Note: Includes four participants who had participated in the clinic intervention prior to withdrawing consent
Table 6-11. Referrals to radiology and allied health services

<table>
<thead>
<tr>
<th>Type of allied health service</th>
<th>Referrals (in total) n (%)</th>
<th>Initiated by ACE clinic n=21</th>
<th>Initiated by others n=57</th>
<th>Referrals not consistent with the ACE treatment plan n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiotherapy</td>
<td>28 (35.9)</td>
<td>5</td>
<td>23</td>
<td>6 (20.0)</td>
</tr>
<tr>
<td>Radiology</td>
<td>19 (24.3)</td>
<td>8</td>
<td>11</td>
<td>9 (30.0)</td>
</tr>
<tr>
<td>Pain management&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12 (15.4)</td>
<td>3</td>
<td>9</td>
<td>8 (26.7)</td>
</tr>
<tr>
<td>Massage</td>
<td>7 (9.0)</td>
<td>3</td>
<td>4</td>
<td>3 (10.0)</td>
</tr>
<tr>
<td>Chiropractic</td>
<td>4 (5.1)</td>
<td>0</td>
<td>4</td>
<td>4 (13.3)</td>
</tr>
<tr>
<td>Psychology</td>
<td>3 (3.8)</td>
<td>2</td>
<td>1</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Osteopathy</td>
<td>2 (2.6)</td>
<td>0</td>
<td>2</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Return to work program</td>
<td>2 (2.6)</td>
<td>0</td>
<td>2</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Occupational therapy</td>
<td>1 (1.3)</td>
<td>0</td>
<td>1</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Note. Referrals were initiated by the ACE treatment plan, treating physician, self-referral, or at the request of lawyer or insurer.
<sup>a</sup> Includes prescription analgesia and corticosteroid injection

6.4.3. Health status measures - Study group comparative analysis

6.4.3.1. Baseline health measures

The baseline health measures are shown in Table 6-12. No significant differences were found between the groups. Adjustment for significant differences in baseline injury factors (presence of a neck or back injury, and number of injury sites reported) did not
change the presence or absence of statistical differences in the measures of outcome between the two groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control n=95</th>
<th>Intervention n=98</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 Physical Component Score (0-100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>36.5 (9.44)</td>
<td>35.3 (8.62)</td>
<td>1.1 (1.30)</td>
<td>-1.4 – 3.7</td>
<td>0.379</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>37 (30 – 43)</td>
<td>34 (29 – 41)</td>
<td></td>
<td></td>
<td>0.363</td>
</tr>
<tr>
<td>SF-36 Mental Component Score (0-100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>32.8 (14.40)</td>
<td>32.6 (13.30)</td>
<td>0.2 (1.99)</td>
<td>-3.7 – 4.2</td>
<td>0.901</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>33 (22 – 43)</td>
<td>31 (24 – 43)</td>
<td></td>
<td></td>
<td>0.831</td>
</tr>
<tr>
<td>Functional Rating Index (0-100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>55.2 (22.04)</td>
<td>55.9 (20.12)</td>
<td>-0.7 (3.04)</td>
<td>-6.7 – 5.3</td>
<td>0.815</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>58 (43 – 75)</td>
<td>60 (45 – 70)</td>
<td></td>
<td></td>
<td>0.956</td>
</tr>
<tr>
<td>Pain Intensity Score (0-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>2.0 (.84)</td>
<td>2.0 (.79)</td>
<td>-0.1 (.12)</td>
<td>-0.2 – 0.2</td>
<td>0.920</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>2 (1 – 3)</td>
<td>2 (1 – 3)</td>
<td></td>
<td></td>
<td>0.908</td>
</tr>
<tr>
<td>Hospital Anxiety and Depression Scale (HADS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety (0-21)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>9.2 (4.47)</td>
<td>9.1 (4.66)</td>
<td>0.1 (.66)</td>
<td>-1.2 – 1.5</td>
<td>0.932</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>9 (5 – 12)</td>
<td>9 (6 – 12)</td>
<td></td>
<td></td>
<td>0.992</td>
</tr>
<tr>
<td>Depression (0-21)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>6.2 (4.12)</td>
<td>6.4 (4.11)</td>
<td>-0.2 (.59)</td>
<td>-1.4 – 1.0</td>
<td>0.739</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>5 (3 – 9)</td>
<td>6 (3-9)</td>
<td></td>
<td></td>
<td>0.717</td>
</tr>
</tbody>
</table>

6.4.3.2. Health status measures over time

To determine the effect of the intervention on health outcome over 12 months, the cohort was examined based on study group status (control or intervention group). Regression analyses were used to account for group imbalances and differences in response rate at each time point, and to control for confounders. Model estimates are reported.
Univariate analyses were first performed to identify variables to include in the final regression models. Results from the univariate analyses for physical and psychological health are reported first, followed by results for the final multiple regression model.

6.4.3.3. Physical health univariate analysis

Simple regression was performed to identify variables that were associated with physical and psychological health measures. The following variables were entered separately into each model: age; gender; level of education; employment status; LOTE; ISS group; number of injured body sites; presence of a neck or back injury; fault status; compensation status and legal representation.

Level of education (p=0.029), number of injured body sites (p<0.001), fault status (p=0.003), compensation status (p<0.001) and legal representation (p=0.004) were associated with worse PCS.

Age (p=0.003), gender (p<0.001), level of education (p=0.017), employment status (p=0.004), number of injured body sites (p=0.002), fault status (p=0.013), compensation status (p=0.002) and legal representation (p=0.006) were associated with worse FRI.

The unadjusted associations between explanatory variables and physical health measures are shown in Appendix Table C 5.

6.4.3.4. Psychological health univariate analysis

Gender (p=0.004), compensation status (p=0.014) and legal representation (p=0.001) were associated with poorer MCS.
Gender (p=0.003), compensation status (p=0.034) and legal representation (p=0.015) were associated with poorer HADS-a.

Gender (p=0.013), compensation status (p=0.004) and legal representation (p=0.009) were associated with poorer HADS-d.

The unadjusted associations between explanatory variables and psychological health measures are shown in Appendix Table C 6.

6.4.3.5. Physical health multiple regression analysis

Linear mixed models were created for continuous outcomes to adjust for differences between the groups regarding potential confounders on the outcomes. Based on the univariate analyses and clinical relevance, the final model used fixed effects of age, gender, ISS group, time, study group and the time by study group interaction term. The effect of the intervention on health status is shown in Table 6-13.

Over the duration of the study there was no significant difference in the overall SF-36 PCS (mean difference 1.0; 95%CI -0.6 to 2.2), FRI (mean difference -1.9; 95%CI -5.4 to 1.6) with reference to intervention or control group status.

6.4.3.6. Psychological health multiple regression analysis

Over the duration of the study, HADS-a was significantly higher (worse) in the control group (mean difference -0.7; SE 0.33; p=0.028). There were no differences in the overall HADS-d (mean difference -0.2; 95%CI -0.8 to 0.4) scores or SF-36 MCS (mean difference 1.3; 95% CI -0.7 to 3.3).
Table 6-13. Association of intervention and health status measures, using linear mixed model analyses\(^a\) (Intervention - Control)

<table>
<thead>
<tr>
<th>Health status measure</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 PCS(^b)</td>
<td>1.1 (0.82)</td>
<td>-0.6 to 2.7</td>
<td>0.200</td>
</tr>
<tr>
<td>FRI(^c)</td>
<td>-1.9 (1.75)</td>
<td>-5.4 to 1.6</td>
<td>0.280</td>
</tr>
<tr>
<td><strong>Psychological health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 MCS(^b)</td>
<td>1.3 (1.00)</td>
<td>-0.7 to 3.3</td>
<td>0.192</td>
</tr>
<tr>
<td>HADS Anxiety(^c)</td>
<td>-0.7 (0.33)</td>
<td>-1.4 to -0.1</td>
<td>0.028</td>
</tr>
<tr>
<td>HADS Depression(^c)</td>
<td>-0.2 (0.30)</td>
<td>-0.8 to 0.4</td>
<td>0.504</td>
</tr>
</tbody>
</table>

\(a\) Fixed effects were baseline health measure mean score, age, gender, ISS group, time, study group and time by study group interaction
\(b\) A positive mean difference indicates that the control group had, on average, a poorer outcome
\(c\) A negative difference indicates that the control group had, on average, a poorer health outcome

6.4.3.7. Improvement over time by study group status / Patterns of recovery

The interaction effect of time and intervention status was not significant for any physical or psychological health measure, indicating that the rate of recovery was the same for the control and intervention groups.

Table 6-14 shows the marginal mean scores for each health status measured at baseline, six months and 12 months following RTC by study group status. The consistent difference between the groups indicates that the intervention was associated with better scores on all measures at each time point, except PCS at 12 months; however, these differences were not statistically significant. These patterns of recovery are shown graphically in Figure 6-2.
<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Intervention Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean (SE)</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>Physical Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 PCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>36.5 (0.97)</td>
<td>34.5 – 38.4</td>
</tr>
<tr>
<td>6 months</td>
<td>49.2 (0.92)</td>
<td>47.5 – 51.1</td>
</tr>
<tr>
<td>12 months</td>
<td>48.5 (0.93)</td>
<td>46.7 – 51.1</td>
</tr>
<tr>
<td>FRI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>55.2 (2.26)</td>
<td>50.7 – 59.6</td>
</tr>
<tr>
<td>6 months</td>
<td>22.8 (1.89)</td>
<td>19.1 – 26.5</td>
</tr>
<tr>
<td>12 months</td>
<td>23.0 (1.90)</td>
<td>19.3 – 26.8</td>
</tr>
<tr>
<td><strong>Psychological health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 MCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>32.8 (1.48)</td>
<td>29.9 – 35.8</td>
</tr>
<tr>
<td>6 months</td>
<td>43.5 (1.19)</td>
<td>41.1 – 45.8</td>
</tr>
<tr>
<td>12 months</td>
<td>43.1 (1.20)</td>
<td>40.1 – 45.4</td>
</tr>
<tr>
<td>HADS - Anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>9.2 (0.46)</td>
<td>8.3 – 10.1</td>
</tr>
<tr>
<td>6 months</td>
<td>7.1 (0.38)</td>
<td>6.3 – 7.8</td>
</tr>
<tr>
<td>12 months</td>
<td>7.7 (0.38)</td>
<td>7.0 – 8.5</td>
</tr>
<tr>
<td>HADS - Depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>6.2 (0.42)</td>
<td>5.4 – 7.1</td>
</tr>
<tr>
<td>6 months</td>
<td>4.1 (0.34)</td>
<td>3.4 – 4.8</td>
</tr>
<tr>
<td>12 months</td>
<td>4.3 (0.35)</td>
<td>3.7 – 5.0</td>
</tr>
</tbody>
</table>

*Marginal means based upon a linear fixed effect model with age, gender, ISS group, baseline health measure, time and study group as fixed effects. Baseline measure is actual mean*
Figure 6-2. Patterns of recovery as measured by the model estimate* for each health measure by study group

*All results are model estimates with fixed effects age, gender, time, baseline health measure, study group status.
6.4.4. Compensation Effect

This section addresses the final hypothesis relating to compensation. Firstly, the association of the intervention in a sub-group of people claiming compensation is reported; followed by the association of compensation and health for the whole cohort. Finally, the interaction of the intervention and compensation on health is reported.

6.4.4.1. Association of the Intervention and claimants

To assess the effect of the intervention on people who claimed compensation, participants who had lodged a compensation claim were analysed as a sub-group. Of the control group participants, 31 (33%) had lodged a compensation claim, compared with 36 (37%) in the intervention group. Linear mixed models were created to test the association with fixed effects of age, gender, ISS group, time, study group and the time by study group interaction term. The effect of the intervention on health status in claimants is shown in Table 6-15.

6.4.4.1.1. Physical health

There was no significant difference in the overall SF-36 PCS (mean difference 1.8; 95%CI -1.6 to 5.2) or FRI (mean difference -1.8; 95%CI -9.1 to 5.5) of claimants with reference to intervention or control group status.
6.4.4.1.2. Psychological health

There was no significant difference in the overall SF-36 MCS (mean difference 0.1; 95%CI -4.0 to 4.0), HADS-a (mean difference -0.3; 95%CI -1.7 to 1.1) or HADS-d (mean difference -0.3; 95%CI -1.0 to 1.6) of claimants with reference to intervention or control group status.

<table>
<thead>
<tr>
<th>Health status measure</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 PCS\textsuperscript{b}</td>
<td>1.8 (1.70)</td>
<td>-1.6 to 5.2</td>
<td>0.297</td>
</tr>
<tr>
<td>FRI\textsuperscript{c}</td>
<td>-1.8 (3.67)</td>
<td>-9.1 to 5.5</td>
<td>0.628</td>
</tr>
<tr>
<td>SF-36 MCS\textsuperscript{b}</td>
<td>0.1 (2.02)</td>
<td>-4.0 to 4.0</td>
<td>0.980</td>
</tr>
<tr>
<td>HADS Anxiety\textsuperscript{c}</td>
<td>-0.3 (0.72)</td>
<td>-1.7 to 1.1</td>
<td>0.687</td>
</tr>
<tr>
<td>HADS Depression\textsuperscript{c}</td>
<td>-0.3 (0.65)</td>
<td>-1.0 to 1.6</td>
<td>0.682</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Fixed effects were baseline health measure mean score, age, gender, ISS group, time, study group and time by study group interaction
\textsuperscript{b} A positive mean difference indicates that the control group had on average a poorer outcome
\textsuperscript{c} A negative difference indicates that the control group had on average a poorer health outcome

6.4.4.2. Association of compensation status and health – entire cohort

To assess the effect of compensation on health for the entire cohort, while controlling for study group allocation, compensation status was introduced into the model.

Compensation was categorised into three independent groups: those not eligible to claim compensation (not-compensable); those who were eligible to claim compensation and lodged a claim (compensation-claim); and those who were eligible to claim compensation, but did not lodge a claim (Compensable but no claim).
6.4.4.2.1.  *Physical health*

After adjusting for confounders, participants who were in the compensation-claim group displayed significantly worse PCS (mean difference 3.0 (SE 1.02); 95%CI 1.0 to 5.0; p=0.004) and FRI (mean difference -4.9 (SE 2.25); 95%CI -9.1 to -0.4; p=0.032) compared with those in the not-compensable group. Additionally, participants who were in the compensation-claim group showed significantly worse PCS (mean difference 2.7 (SE 0.97); 95%CI 0.8 to 4.6; p=0.005) and FRI (mean difference -4.6 (SE 2.10); 95%CI -8.7 to -0.5; p=0.030) than those who were in the compensable but no claim group.

6.4.4.2.2.  *Psychological health*

Participants who were in the compensation-claim group displayed significantly worse HADS-d (mean difference -0.8 (SE 0.36); 95%CI -1.5 to -0.1; p=0.020) than those who were in the compensable, but no claim group. While there was a trend for the compensation-claim group to show poorer psychological health on the MCS and HADS-a measure, these differences did not reach statistical significance. The association of compensation on health is shown in Table 6-16.
Table 6.16. Association of compensation and health status measures, with compensation-claim participants as the baseline for comparison, using linear mixed model analyses\textsuperscript{a}

<table>
<thead>
<tr>
<th>Health status measure</th>
<th>Compensation status</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 PCS\textsuperscript{b}</td>
<td>Not-compensable</td>
<td>3.0 (1.02)</td>
<td>1.0 to 5.0</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Compensable but no claim</td>
<td>2.7 (0.97)</td>
<td>0.8 to 4.6</td>
<td>0.005</td>
</tr>
<tr>
<td>FRI\textsuperscript{c}</td>
<td>Not-compensable</td>
<td>-4.9 (2.25)</td>
<td>-9.1 to -0.4</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>Compensable but no claim</td>
<td>-4.6 (2.10)</td>
<td>-8.7 to -0.5</td>
<td>0.030</td>
</tr>
<tr>
<td>SF-36 MCS\textsuperscript{b}</td>
<td>Not-compensable</td>
<td>1.7 (1.33)</td>
<td>-0.9 to 4.3</td>
<td>0.210</td>
</tr>
<tr>
<td></td>
<td>Compensable but no claim</td>
<td>2.4 (1.21)</td>
<td>0.0 to 4.7</td>
<td>0.048</td>
</tr>
<tr>
<td>HADS Anxiety\textsuperscript{c}</td>
<td>Not-compensable</td>
<td>-0.7 (0.43)</td>
<td>-1.5 to 0.2</td>
<td>0.116</td>
</tr>
<tr>
<td></td>
<td>Compensable but no claim</td>
<td>-0.7 (0.40)</td>
<td>-1.5 to 0.1</td>
<td>0.074</td>
</tr>
<tr>
<td>HADS Depression\textsuperscript{c}</td>
<td>Not compensable</td>
<td>-0.7 (0.39)</td>
<td>-1.4 to -0.1</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>Compensable but no claim</td>
<td>-0.8 (0.36)</td>
<td>-1.5 to -0.1</td>
<td>0.020</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Fixed effects were age, gender, baseline health measure mean score, ISS group, time, Study Group (allocation) status and compensation. Comparator is Compensable and Claimed group.
\textsuperscript{b} A positive mean difference indicates that the Compensable and Claimed group had, on average, a poorer outcome.
\textsuperscript{c} A negative difference indicates that the Compensable and Claimed group had, on average, a poorer health outcome.

6.4.4.3. **Interaction of compensation and study group status**

The interaction of compensation and study group status was introduced into the model but was not statistically significant for any measure. This indicates that the intervention did not have a greater effect on people with different compensation status. That is, the
control and the intervention participants had a similar outcome, regardless of compensation status.

6.4.5. Exploratory analysis

Further exploratory analysis was performed to firstly compare health outcomes for intervention participants who adhered with the treatment programme; and secondly to attempt to identify sub-groups who may have benefited from the intervention.

6.4.5.1. Comparison of compliers with non-compliers

At the three-month follow-up phone-call 19 (20%) participants were considered to have not complied with the intervention. That is, between the last contact with the ACE clinic and the three-month follow-up call, the participant was either undergoing treatments that were considered inappropriate; or did not follow through with the ACE clinic referral to allied services (e.g. failed to attend physiotherapy). Types of advice or treatments considered inappropriate included: referral to radiology on the advice of the insurer or legal provider; receiving weekly passive therapy with no structured rehabilitation programme; and taking regular opioid-based analgesia without performing any physical rehabilitation. Participants who were non-compliant were more likely to be female, older and have lodged a compensation claim. In terms of health, they had worse physical health at baseline (FRI and pain intensity) and continued to have worse physical health at six months (FRI, pain intensity and PCS) (See Table 6-17).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Complied</th>
<th>Non-compliant</th>
<th>mean diff (SE)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline n=76</td>
<td>Baseline n=19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 month n=74</td>
<td>6 month n=14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>36 (13.8)</td>
<td>45 (13.6)</td>
<td>-9.2 (3.54)</td>
<td>0.009</td>
</tr>
<tr>
<td>Female, %</td>
<td>55.4</td>
<td>81.0</td>
<td></td>
<td>0.043</td>
</tr>
<tr>
<td>Employed, %</td>
<td>85.1</td>
<td>76.2</td>
<td></td>
<td>0.336&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fault status = Not at fault, %</td>
<td>71.1</td>
<td>84.2</td>
<td></td>
<td>0.266</td>
</tr>
<tr>
<td>Lodged a compensation claim, %</td>
<td>33.8</td>
<td>61.9</td>
<td></td>
<td>0.025</td>
</tr>
<tr>
<td>Days from crash to 1&lt;sup&gt;st&lt;/sup&gt; clinic</td>
<td>10.2 (5.60)</td>
<td>9.3 (4.53)</td>
<td>0.9 (1.34)</td>
<td>0.808&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Health Measures, mean (SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRI</td>
<td>52.7 (19.90)</td>
<td>66.6 (17.18)</td>
<td>-13.0 (5.98)</td>
<td>0.006</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>1.9 (0.78)</td>
<td>2.3 (0.75)</td>
<td>-0.5 (0.20)</td>
<td>0.022</td>
</tr>
<tr>
<td>SF-36 PCS</td>
<td>36.4 (9.17)</td>
<td>32.4 (4.80)</td>
<td>4.0 (2.18)</td>
<td>0.068</td>
</tr>
<tr>
<td>SF-36 MCS</td>
<td>33.9 (13.92)</td>
<td>27.3 (9.73)</td>
<td>6.6 (3.39)</td>
<td>0.056</td>
</tr>
<tr>
<td>HADS-Anxiety</td>
<td>9.0 (4.80)</td>
<td>9.5 (4.07)</td>
<td>-0.6 (1.20)</td>
<td>0.645</td>
</tr>
<tr>
<td>6 month Health Measures, mean (SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRI</td>
<td>17.1 (2.17)</td>
<td>33.0 (5.84)</td>
<td>-15.9 (5.51)</td>
<td>0.005&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>0.7 (0.10)</td>
<td>1.3 (0.27)</td>
<td>-0.6 (0.25)</td>
<td>0.027&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SF-36 PCS</td>
<td>50.9 (8.49)</td>
<td>44.5 (9.78)</td>
<td>6.4 (2.55)</td>
<td>0.014&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SF-36 MCS</td>
<td>44.7 (12.37)</td>
<td>46.6 (8.52)</td>
<td>-1.9 (3.47)</td>
<td>0.990&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>HADS-Anxiety</td>
<td>6.5 (0.52)</td>
<td>6.7 (1.14)</td>
<td>-0.3 (1.25)</td>
<td>0.764&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Fishers Exact test
<sup>b</sup> Mann Whitney U-test
6.4.5.2. **Effect of the intervention on different grades of disability and anxiety**

To test the effect of the intervention on different baseline disability grades, the baseline FRI score was categorised into minimal (0-20%); moderate (21-40%); severe (41-60%); and very severe (>61%) disability as per established cut-offs (151). The regression model included fixed effects of age; gender; time; study group; and the study group by baseline disability grade interaction term. The interaction term was not significant (p=0.654), indicating that the treatment effect was similar across all disability grades.

A similar model was created to test the effect of the intervention on baseline anxiety grades. Baseline anxiety score was categorised into normal (0-7); mild (8-10); moderate (11-15); and severe (16-21) anxiety, as per established cut-offs (158). The interaction term of study group and anxiety grade was not significant (p=0.948) indicating that the treatment effect was similar across all anxiety grades.

6.4.6. **Summary of main results**

1. The intervention was not associated with improvement in physical health.

2. The intervention was associated with a small improvement in anxiety levels, but otherwise there was no effect on psychological measures.

3. The intervention was not associated with better health for people claiming compensation.
6.5. Discussion

This study compared the effect of an early assessment and treatment coordination programme on health outcomes for people with mild to moderate MSK injuries following a RTC with standard care alone. Firstly, it demonstrated that long-term physical health outcomes did not differ for participants receiving the intervention. Secondly, it showed that the intervention resulted in greater improvement in some aspects of psychological health, most notably in measures of anxiety but the difference between the treatment groups was not large, and was not clinically significant. Over the 12-month period there was a trend towards better physical and psychological health in the intervention group, however, this did not reach statistical or clinical significance. Thirdly, the intervention was not associated with better health in people who claimed compensation. While participants who claimed compensation demonstrated worse health than both those who were ineligible for compensation, and those who were compensable but chose not to claim compensation, the effect of the intervention did not differ between the different compensation statuses. The cohort was characterised by high levels of disability and anxiety in the immediate post-crash period. There was a significant improvement in all measures of health between baseline and six months, but no further improvement between six months and 12 months.

There are a number of possible explanations for the lack of statistically and clinically significant findings. The magnitude of the observed effect on the primary outcome measure (SF-36 PCS) was well below the a priori definition of a minimally clinically important difference, that is, 10 points. The observed loss to follow-up was less than that
which had been allowed for in the sample size calculation (18.2% versus 30%). However, despite the sample size calculation allowing for a minimally important difference of 10 points, the necessity to apply more sophisticated analysis probably resulted in the study being under-powered.

Additional reasons the intervention could not be shown to be effective at improving health status, with the possible exception of a small improvement in anxiety for the intervention group, relate to the design and implementation of the intervention. First, the intervention may have required a more intensive follow-up of participants. The intervention focussed on providing reassurance, setting realistic goals for recovery, managing pain and promoting mobilisation through a self-managed home-exercise programme. Participants may have benefited from more support from the ACE clinic while they were self-managing. Follow-up phone-calls made by the nurse educator identified 34 (35.8%) participants who required further ACE clinic physician review at some stage of the three-month intervention. The purpose of the review was to reinforce the key messages about managing pain, clarify exercise technique, reassure the patient that there was no major injury and encourage mobilisation of the injured area. In an evaluation of an active treatment plan that incorporated a home-exercise programme in people with WAD, it was shown that the instruction-treatment sessions needed to repeated on average 3.95 times over the initial 20-day protocol (127). In the current study participants required, on average, two (range 1-5) appointments with the ACE clinic physician and two (range 1-5) contacts with the nurse educator. The results suggest that the number and method of follow-up (phone versus face-to-face review) may have
needed to be more intensive in order to provide some patients with the reassurance and advice they required.

Further support for more intensive follow-up can be derived from the data related to the participants who failed to comply with clinic advice. Of the 39 participants who failed to comply with the treatment plan at some stage during the initial three months, half were reviewed by the ACE clinic and resumed their programme as per the initial recommendations. At the three-month final follow-up phone-call however, 21 of these participants continued to complain of ongoing pain. Contrary to the treatment plan recommendations, these participants were either using opioid-based analgesia sporadically for pain management, were attending physiotherapy, chiropractic or massage therapists on a regular basis, or undergoing further radiological investigations. Although it was not specifically assessed, it is assumed that something, perhaps an episode of pain which may or may not have been related to their original injury, caused these participants to seek further services from external healthcare providers. People who failed to comply were more likely to be female, older and have lodged a compensation claim. In terms of health, they had worse physical health at baseline (FRI and pain intensity), and continued to display poorer physical health at six months (FRI, pain intensity and PCS). These results suggest that people who had greater pain and disability at baseline required more intensive care and follow-up. The clinic may not have met their needs in terms of managing pain, or they disregarded the advice provided in the programme. Both of these scenarios may have been better managed with closer follow-up of participants in the first three months of injury.
A second reason for lack of significant improvement in health status relates to compliance with the self-managed treatment advice. Compliance with home-exercise programs for management of MSK injuries has been reported to be as low as 41% (100). It is unclear as to what extent participants followed the treatment plan, particularly with respect to performing the home-exercises and taking regular, simple analgesia. If the intervention was effective, lack of compliance with an aspect of the treatment plan, would bias the observed effect to the null.

Other possible explanations for lack of significant findings relate to study design, namely group imbalances in injury severity and timing of collection of follow-up data. There were a higher number of injuries reported by the intervention group which may suggest group imbalances in terms of severity of injury. However, the higher number of reported injuries did not translate into a higher ISS. It is difficult to determine if this variable is a true measure of injury severity, or a proxy for some psychological effect relating to over-reporting. A greater number of participants in the intervention group reported an injury to the neck or back compared with the control group. There is no obvious reason for the difference. However, neither of these findings (higher number of reported injuries, presence of neck/back injury) influenced baseline health measures. Additionally, controlling for these variables in the models did not have any meaningful influence on the results, so it is unlikely that differences in type and severity of injury could account for lack of significant findings, nevertheless, it cannot be ruled out as a possibility.

Finally, timing of the outcome assessments may explain the lack of significant findings. The intervention focussed on early mobilisation; encouraging people to return to normal
activities as quickly as possible. The benefit of early mobilisation would be expected within three months of injury. Changes in physical and functional health would be expected sooner than the six-month assessment point which was used. So while there was no difference in physical or functional health measures between the groups at six months, it is conceivable that the intervention group returned to health faster than the control group.

Overall, the results of this study suggest that the intervention as conceptualised was ineffective. Specifically, a sports injury model may not be appropriate for people with musculoskeletal injury in the setting of a RTC. Both the needs of this group of people and the resources available to them are different to those of sporting professionals. It is likely that psychological factors are powerful contributors to recovery and a sports injury model is unlikely to address these effectively.

Over the duration of the study, the intervention group reported lower anxiety related symptoms compared with the control group. A study of patients with chronic obstructive pulmonary disease determined a minimally important difference of 1.5 points for the HADS (182), so the difference of 0.7 points (9.1% change) in the current study is unlikely to be clinically relevant. Studies have shown that active coping styles and self-efficacy are associated with improved outcomes following RTC (99-101). Providing patients with reassurance and a realistic understanding of their injury severity can give the patient confidence to self-manage and reduce their fear and anxiety in relation to their injury. Stress and anxiety have been shown to predict occurrence and outcome in neck and back pain (23, 65, 67, 80, 145, 146). It is reasonable to suggest that reducing anxiety
contributed to a favourable improvement in functional and physical health in patients in the intervention group.

The intervention was not associated with better health for people claiming compensation. Overall, people claiming compensation reported worse health, and this is consistent with previous studies (19, 107, 113). The intervention encouraged people to self-manage; it provided reassurance of the benign nature of the injury and promoted a return to normal activities. These messages conflict with those delivered within a compensation environment. The compensation process focuses the injured person on the potential for long-term disability and a negative outcome. It encourages the use of medical resources, not for the purpose of recovery, but to assess the extent of disability and predict its future course. Thus, while the compensation system focuses on the potential for harm, the intervention programme focussed on the likelihood of a fast recovery. This suggests that despite delivering positive messages affirming a good prognosis, these messages might be over-ridden by those generated due to contact with the compensation system.

There were no differences in the claim rates between the control and intervention group, which confirms that the intervention programme did not influence a person’s inclination to claim. If the motivation for claiming compensation is an expectation of poor recovery and long-term disability, then this intervention, which focussed on reassuring the patient of expectation for a good prognosis was not effective.

On most health measures, the people who claimed compensation displayed poorer health compared to the people who did not claim compensation. The differences are most obvious on the physical and functional measures. It is possible that, for people who are
eligible to claim compensation, the impetus for lodging a claim is a worse initial injury state and that this worse state contributes to the overall poorer long-term outcome in people claiming compensation. However, that does not explain why people who were not eligible to claim compensation reported better health on all measures. It would be expected that there should be a similar number of badly injured people, who consequently have a poorer outcome amongst the people who are not eligible for compensation, however there was no evidence of that effect. This suggests, in the context of this study, people who claimed compensation had a poorer outcome regardless of injury severity.

It is feasible that there is something fundamentally different about people who claim; that is, they are a more vulnerable group prior to the crash. This study demonstrated that people who claim compensation report higher pain and disability and greater anxiety than those who do not claim, despite no differences in injury severity. A Danish study of people with mild to moderate injuries following a RTC demonstrated that people who claimed compensation had higher pre-crash health utilisation in the 12 months prior to the crash compared with a control group (183). The study found that people who chose to claim in the future had a higher proportion of health disorders and a much higher use of prescription drugs. This suggests that people who claim compensation require a different type of management because they have a different pre-crash health profile. Consequently, they may benefit from a more structured and supportive approach to care. An alternative approach to the intervention would be to target those people with initially very high pain, very high disability or very high psychological distress levels. These sub-
groups of people are the ones most likely to benefit from a more intensive and more psychologically based intervention.

The challenge is in identifying those people at greatest risk of poor recovery at the earliest possible time, to provide the best potential for recovery. The use of health screening tools in the ED and general practices may be a useful strategy. People in high-risk groups could subsequently be referred to an assessment and treatment coordination clinic similar to the one trialled in the current study.

Additionally, from an insurer’s perspective there may be benefit in exploring opportunities that link or flag comprehensive car claims to the CTP insurer. In this study it was noted that crashes were reported to the relevant comprehensive car insurer very early post-crash. It appeared that the focus for the injured person was on fixing the car to provide transport for the injured person while they recovered their health. A mechanism that flagged a potential claimant to the CTP insurer may reduce the time to commencement of treatments. Privacy regulations may restrict the sharing of data between the comprehensive car insurer and CTP insurer. If that is the case, rather than the comprehensive car insurer alerting the CTP insurer of a potential claimant, the CTP insurer, by establishing collaborative commercial relationships with the comprehensive car insurer could, in effect get them (the comprehensive insurer) to direct injured people back to the CTP insurer.

Another approach to early identification of high risk claimants is for CTP insurance regulators to consider administering health screening tools at the time of policy renewal. It should be acknowledged that in fault-based insurance schemes, the CTP policyholder is
not the direct beneficiary of the delivered care and treatment. The policy covers the third 
party, i.e. the person / people that are injured due to the policyholder's wrong-doing. 

Administering a health screening tool to the policyholder will not inform decisions around 
how to manage the third party's care. However, when it is administered by the regulator, 
which has visibility over all policyholders regardless of the insurer/ policy underwriter, it 
does assist in gathering information on a large proportion of the population within a state 
or territory. This serves the purpose of identifying policyholders who, in the event of a 
crash, are most likely to be at high-risk of poor recovery.

6.5.1. Strengths and limitations

There are a number of strengths to this study including the use of well-validated outcome 
measures and a well-defined cohort studied from an early period post-crash. Reliable 
claims data were extracted from the sole insurer in the jurisdiction, minimising the chance 
of differing claims management models influencing the results.

A number of limitations may have affected the results. These limitations include study 
design; follow-up; and measures of injury severity and pre-injury health. Firstly, whilst it is 
accepted that the gold standard of research design is a randomised control trial (RCT), for 
a number of reasons, both practical and ethical, a sequential cohort design, rather than a 
RCT, was viewed to be the appropriate design with which to implement and evaluate the 
ACE programme in the ACT. The first consideration relates to health provider bias. A RCT 
would have potentially had a treating physiotherapist caring for two patients who may 
have been randomised into different arms of the trial; one participant receiving "usual 
care" and the other under the guidance of the ACE programme. It would have been
difficult to ensure that provider behaviour was independent for each patient. The only method of achieving independent behaviour would be to prevent the participant returning to their usual providers for treatment, and control all elements of their care at the clinic. It was never intended to control the care of patients through the ACE programme but rather, to accurately assess and develop treatment plans that focus on achieving acceptable recovery outcomes based on evidenced based guidelines.

A cluster RCT design was considered as an alternative to the sequential cohort. That is, to conduct the two arms of a RCT in different cities to avoid the abovementioned problems. However, a significant variable relates to the health and compensable schemes within which the injured people are treated. Comparing the clinical intervention in, for example, a Queensland city to a control in the ACT does not capture the consistent influence of the ACT health and CTP scheme. For these reasons the sequential cohort design was deemed to be the most practical and robust option.

The sequential cohort design may have contributed to selection bias during the recruitment period. People who declined to participate in the intervention phase of the study usually cited that they were ‘not injured enough’ to warrant the services of a specialist physician. It is possible that people who declined to participate in the intervention group would otherwise have given consent had they been invited to participate in the control group. In the control group, the injured person needed only to have been in a crash and be willing to complete a series of research questionnaires in order give consent. Their perceived injury state would not have contributed to their
decision to participate. Consequently selection bias during the recruitment phase cannot be ruled out, despite there being no major differences observed in injury severity.

There was a non-significant trend to greater non-response in the intervention group (21.1% versus 13.7%). Non-responders were more likely to have a higher number of injured body sites and have lodged a compensation claim. There are a number of possible explanations for non-response. Firstly, intervention participants received clinical care in a research environment in the initial weeks following their crash. Once their involvement with the clinic was completed, in the participant’s mind, their commitment to the study was also complete. A second reason is that participants who did not respond in the intervention group may have seen no benefit from their experience with the treatment programme. A perceived lack of benefit from the programme may have translated into low motivation to continue to respond to the follow-up at six and 12 months. A third reason for the loss to follow-up may be that participants had received advice not to participate further. The written communication between the clinic physician and patient’s GP detailed a very clear assessment, treatment plan and expected course of recovery. If advice in the medical notes and communications did not meet the needs of a particular party in the negotiation of an insurance claim, the participant may have been advised to stop involvement in the study. Given that three of the four formal withdrawals in the intervention group withdrew their consent on the advice of their lawyer, it is not unreasonable to consider that some of the non-responders had been similarly advised, either by their lawyer or other interested party.
Another weakness relates to the measure used for assessing injury severity. A number of methods were used to attempt to get a robust measure of injury severity. The ISS was strongly positively skewed and contained outliers. Both of these are known characteristics of the ISS (149). Log transformation did not improve its properties. The number of outliers decreased, however they remained influential in the linear modelling. ISS was subsequently categorised into minor (1-3) and moderate (>=4). The distribution of MAIS revealed small numbers in the higher category of severe leading to imbalances and influential outliers. Examination of scatterplots revealed the ISS two-group categorisation to be the most robust measure of injury severity. It is possible that dichotomising this measure resulted in a lack of discrimination between different injury states.

Finally, it was not possible to assess pre-injury health and psychological status. Both of these factors have previously been shown to influence outcome (22, 40, 74, 75) and should be considered as possible explanatory factors.

6.6. Conclusions

The results of this study do not support the implementation of an assessment and coordination programme, in the trialled form, for people injured in RTCs. While the direction of effect was positive for all health measures, the differences were neither clinically nor statistically significant.

The intention of this intervention was not to control the injured person's care, but rather to assess injuries and guide a predominantly self-managed recovery, using evidence-based treatments. The key concepts of the programme were education, reassurance, early
mobilisation and pain management. Had it been possible to fully control participant’s treatment through a more coordinated approach to delivery of co-interventions from GPs and allied health professionals, the results may have been different. Research has shown that early return to normal activity and rehabilitation exercises are effective in managing MSK injuries (142). However, in the context of the immediate post-crash period, where some injured people are in a fragile and vulnerable state, there does appear to be a need for some people to be supported with a more ‘hands-on’ approach. The challenge is to deliver that support without creating an environment that leads to therapist dependence.

There may be sub-groups that respond to this type of intervention, but this study was unable to identify those groups. Future work should concentrate on identifying responsive sub-groups and consider targeting those people with an intervention of this type.
Chapter 7. Discussion and Conclusion

This thesis aims to better understand how people recover from musculoskeletal (MSK) injuries sustained in road traffic crashes (RTCs). One of the key factors thought to influence recovery (health outcome) is the clinical care injured people receive in the early stage following a crash. The principles of early intervention, early expert assessment and early mobilisation and structured rehabilitation have been applied effectively in the elite sport setting for some years. It is reasonable to consider their application wherever soft tissue injury has occurred. In the post-crash setting, health care is frequently fragmented and disparate as people consult a number of health service providers in an attempt to confirm their diagnosis, understand their injury, control pain and ultimately achieve functional recovery. Multidisciplinary health clinics have been implemented with varying degrees of success for people with chronic MSK pain (e.g. low back pain, WAD) (139, 141, 154, 184-186). This thesis evaluates an early intervention programme comprising clinical assessment from a MSK physician and treatment planning administered within the first weeks of the crash. The research aims to determine if the early intervention programme is associated with better physical and psychological health for people with mild to moderate MSK injury sustained in a RTC.

The literature review in Chapter 2 reveals the substantial societal and economic burden of minor injury crashes both globally and locally. It shows that recovery is influenced not only by physical factors, but also by psychological factors. Additionally, the structure and features of compensation systems are shown to be associated with health outcome in the
setting of RTCs. The literature reveals that evidence is inconclusive on the precise timing and individual components of the model of care that delivers the most effective approach for a rapid and sustained recovery. Identifying effective post-crash treatment and rehabilitation strategies has the potential to decrease the financial, societal and human costs associated with minor injuries resulting from RTCs.

Three analyses were performed to explore the recovery pathway for people with minor MSK injury sustained in a RTC, and specifically to evaluate the effect of an early intervention programme on health outcome. Each analysis used data from a single cohort of individuals who had presented to the Emergency Department (ED) of Canberra Hospital or Calvary Hospital in the Australian Capital Territory (ACT), having sustained a mild to moderate MSK injury in a RTC.

The first analysis, in Chapter 4, utilised baseline data from all 193 participants and reports the health of injured people in the first week following a crash. Additionally, it stratifies the participants by fault status to determine the association between fault and physical and psychological health outcomes.

The second analysis, in Chapter 5, utilised data from the control group (95 participants) and follows participants over a 12-month period to report on the longer-term recovery of people with minor injury following a crash. It also analyses the study group based on compensation status to compare the physical and psychological health outcomes in participants who had lodged a compensation claim to those who did not lodge a claim.

The final analysis, in Chapter 6, the Accident Care Evaluation (ACE) study, evaluated an early intervention treatment programme for people with minor injury sustained in a RTC.
It compares the long-term health of participants undergoing standard care (control group) to participants who attended the early intervention programme (intervention group). The treatment programme comprised early assessment by a MSK physician and development of a treatment plan, where the primary focus was on self management, education about injury, and pain management.

The three analyses are summarised below.

7.1. **Analysis 1**

Chapter 4 reported the findings of a prospective study of mild to moderately injured patients in the early period following road trauma. Participants were stratified into AF (at fault) and NAF (not at fault) and multivariate analyses were used to determine the association between fault and validated physical and mental health outcomes (SF-36, Functional Rating Index (FRI) and Hospital Anxiety and Depression Scale (HADS). Overall it reveals that the cohort was characterised by severe disability, moderate levels of pain and high levels of anxiety in the immediate period post-crash. When the cohort was examined based on fault status it showed that people who were not at fault in the crash reported worse mental and emotional health (SF-36 mental health and role emotional sub-scale) compared to those people who were responsible for the crash. This suggests that feelings associated with being in a crash that was the fault of another person, such as injustice, victimisation or blame, influence a person’s health response.

An interesting observation was the high level of disability displayed by participants in the first week after their crash. This often seemed disproportionate to the relatively minor
nature of their injury and often affected their ability to perform even the most basic tasks. Intuitively it makes sense that at this point they should be receiving the most support, whether that is from a health (physical) recovery perspective, for example accessing health care services, or in dealing with the other practical issues arising from the crash, such as maintaining work and family commitments, replacing the vehicle, and initiating compensation claims. Strategies aimed at addressing some of these issues such as simplifying the insurance process, providing alternative methods of transport (for example a replacement vehicle), and facilitating access to ongoing medical care, may help reduce stress and therefore improve the overall health outcomes for the injured person.

A second observation, recorded in research notes, and arising from this baseline health analysis was that the level of pain participants experienced increased markedly in the days following the crash. That is, from the time of their initial presentation to, and subsequent assessment in the ED, to baseline data collection (mean 9.3 days), participants remarked that their pain had become much worse. From a clinical perspective, an increase in symptoms in the first few days after trauma is not at all unexpected, however, from the injured lay person’s view, this increase in pain can be alarming. It is reasonable to assume that patients are advised of the expected course of recovery during their ED visit.

However, it is clear that, after a reassuring clinical examination the messages need reinforcing in the days following the crash. This is particularly relevant to advice about pain management. Given the known association between more severe pain and prolonged disability, strategies to manage pain and encourage mobilisation should be instigated early and reinforced in the days after the crash.
The findings that fault is associated with poorer psychological health (as assessed by the SF-36 MCS), but not with any physical outcomes, are important as it has been shown previously that psychological status influences perception of pain and prolongs recovery from MSK injuries (23, 71, 72). This suggests that people not at fault are in a higher-risk group for delayed recovery. The need for timely access to health and medical care following the crash is important in order to identify the people at risk of poor recovery, to reassure them of the non serious nature of their injury, and to provide them with clear treatment advice.

The association between “not at fault” status and poorer psychological measures, but not poorer physical health (pain and disability) raises another point for consideration. The poorer psychological health displayed by people not at fault suggests that the feelings of anger and blame are strong contributing factors to recovery. This observation is important with respect to informing policy on the design of compensation schemes. The premise of fault-based insurance systems is the need to prove that the crash was due to another person’s wrongdoing. The feelings of blame and anger at being involved in a crash that was the fault of someone else may well heighten the stress response. However, removing the need to prove fault may not necessarily change the way an injured person feels about the sense of injustice and blame. The injured person will still be entering the compensation system with some psychological health issues relating to their fault status, regardless of whether they are required to attribute blame in order to access the system.
Selection bias is a potential limitation of this study. It was not possible to contact a large number of prospective recruits in order to invite them to participate in the study. Compared to the study cohort, non-participants were younger and male. Therefore the results may not be generalisable to this population.

Overall, the results of this study provide a greater understanding of the needs of an injured person in the immediate post-crash period. They highlight an important concept in better understanding the reasons for differences in outcomes following RTC-related injuries, particularly in the context of compensation systems. The results expand on previous research showing an association between fault status and poorer psychological health (79, 81, 82, 174, 175).

7.2. Analysis 2

Chapter 6 explored the effect of pursuit of claiming compensation on general health profile up to 12 months post mild to moderate injury. It compared the functional, physical and mental health outcomes of people injured in a RTC who submitted a claim for compensation with those that did not claim compensation. It was found that people who claimed compensation reported worse functional and physical health and greater anxiety over the duration of the study.

The study demonstrated that claiming compensation was associated with worse physical health (PCS, FRI and pain intensity), as well as higher anxiety (HADS-a). Baseline health measures were worse in the compensation group, despite there being no evidence of a more severe crash. It is possible that feelings of anger and blame may have influenced
their baseline measures. This further supports the view that psychological factors play a major role in recovery, and therefore need to be assessed and managed early after injury.

The study demonstrated that although people report poor physical, functional and psychological health initially, overall they recover reasonably well. There was a significant improvement in all measures of health between baseline and six months, but minimal improvement after that time. This suggests that it is possible to predict within six months those people who will need long-term support.

The finding that there was no significant improvement in any measure of health between six and 12 months has implications for the compensation system. It suggests that there is merit in finalising compensation claims for mild to moderate MSK injuries within six months of injury as it likely that recovery has stabilised.

Another consideration that arises from the evidence that significant improvement occurs within the first six months following the crash, relates to management of the injury. If the injury has not stabilised by six months it is reasonable to suggest that the treatment strategies being utilised are ineffective. In the compensation setting, where the insurer is funding the treatment, there is a case for the insurer to take on a more managed and outcome-focused approach to care at this stage of the claim.

One component of the compensation system that was found to have an adverse association with long-term health outcome was the intervention of legal services. Psychological health was predicted by the use of a lawyer in the compensation claim, even after controlling for baseline (post-crash) health. This is a very complex situation. It is possible that claims that require the services of a lawyer are more complex than those
that are managed without one. However, in a minor injury claim, it is arguable where the complexity begins. The lawyer is primarily concerned with justice and financial retribution for his client, and hopes that a good health outcome will eventuate. The clinician is primarily concerned with the eventual health outcome and hopes that justice and financial retribution may also be achieved. While both groups are working in the best interest of their client/patient, the actions of one group may adversely affect the expected outcomes of the other. For example, from the legal perspective it may be important to keep the client focussed on the persistence and severity of symptoms, whereas the clinician’s emphasis may be more on management and reassurance of a favourable outcome. The lawyer, relieves the injured person of the burden of administering the claim, and in doing so, removes at least one of the stresses associated with the crash, that is, the claims management. Simplifying the claims process may negate the need for legal providers, thereby limiting the negative effect on health, while still ensuring that injured people are treated fairly. The association between poor health outcome and the provision of legal services has been demonstrated in previous studies in compensation settings (42, 79, 110, 187). The involvement of lawyers in the personal injury claims process may increase the financial rewards/outcome, but it appears to have an adverse effect on health outcome (25).

The study highlighted that psychological factors, particularly anxiety and mental health, are associated with poor long-term outcome. It was not possible to determine whether pre-injury health status influenced the results. However, regardless of whether the injured person came to the crash with poor psychological health, or the crash contributed
to their worsened state, the role of psychological factors in recovery must be considered when developing treatment strategies.

7.3. Analysis 3

Chapter 6 reported the results of the ACE study, an evaluation of an early intervention programme that comprised early evidenced-based medical assessment, diagnosis and treatment planning. The ACE programme, in essence, consisted of advice, education, reassurance and encouragement to self-manage. The sequential cohort study design provided a pragmatic test of the intervention in the real-world setting. However, no improved health outcomes from the early assessment and treatment coordination clinic were shown. This may in part be explained by the logistical difficulties of trialling this type of intervention in the natural setting.

The intention of the treatment programme was not to control the injured person’s care, but rather, to guide a predominantly self-managed recovery. It is possible that delivering an early, coordinated programme where all elements of care are controlled may prove to be the ideal model. That is, a multidisciplinary team approach, delivering consistent messages from a central facility, with limited requirement for external health providers. Treatment programmes of this design have been used for the management of chronic MSK injuries in workers and RTC settings with varying degrees of success (139, 141, 154, 188). Any multidisciplinary treatment programme considered needs to address both physical and psychological factors of the injured person, while avoiding an over reliance on healthcare providers, and encouraging a self-managed approach.
A further reason for the lack of significant improvement in health status relates to the clinical follow-up support provided for the injured people. Some participants may have required more intensive follow-up and support than the clinic was able to provide. The risk of people feeling left alone to self-manage was mitigated in some way by providing the services of a nurse educator to support and follow-up patients, however, it probably was not sufficient for some. This supports the evidence that self-efficacy and active coping styles are important contributors to recovery from MSK injury (88, 100). It also demonstrates the influence of other psychological factors such as stress and anxiety. Some participants sought frequent reassurance from the ACE clinic physician that their injury was benign, their symptoms were expected, and their course of recovery was anticipated. In practical terms, delivering this type of support service may be logistically difficult and financially costly. It is worth considering whether some elements of the treatment programme could be delivered in alternative ways, for example, in an educational video to reinforce the recovery messages. Furthermore, it is feasible that the treatment programme did not adequately address the psychological factors associated with recovery. The addition of other components to the programme such as motivational interviewing may be beneficial.

The influence of the compensation system and in particular, involvement of a legal provider, on physical and psychological health, is difficult to ignore. On balance, it is not surprising that injured people report worse health in an environment which focuses them on the potential for harm and repeatedly questions them about symptoms, their severity and their significance. Rather than focussing on recovery, the injured person is compelled to focus on their symptoms. Perhaps not surprisingly, when the choice is between
attending a medical provider who will guide a path to recovery, or a lawyer who will
provide a financial reward for demonstrating ill health, the latter option is chosen by some
people.

7.4. Summary of the thesis findings

In summary, this research, performed in a clearly defined cohort, using well validated
health measures, demonstrated that people had severe disability, moderate pain and high
levels of anxiety after sustaining minor injuries in a RTC. It was apparent that injured
people have health needs that are not fully met by the ED. People who are involved in a
crash that was the fault of another person display poorer psychological health, particularly
in terms of emotional and mental health. People who claim compensation report worse
health overall compared to those who do not claim compensation, despite sustaining a
similar severity of injury and there being no discernable difference in the severity of the
crash. In contrast to the primary hypothesis, the research did not show benefit in
providing injured people with access to specialist medical assessment and treatment
planning in the early days following the crash and while it is possible that this indicates
early intervention is ineffective, on face value one would expect it to be beneficial. The
results may in part be explained by the structure of the intervention treatment
programme, in particular, the inability to control all elements of care, and an inability to
fully meet the support requirements of the injured person. Regardless, it is clear that
recovery is influenced by both physical and psychological factors and any model of care
needs to address each of these components.
7.5. Limitations

There are several limitations to this research. They relate to the study design, health measures and intervention design.

7.5.1. Study design

Selection bias, due to non-participation is a potential limitation across each of the studies. Although the rate of decliners was comparable to similar studies, there were a large number of potential recruits who it was not possible to contact in order to invite them to participate in the study. Regardless of the reason for non-participation, people in unmeasured groups were younger males. Consequently the results from each study may not be generalisable to young males.

The sequential cohort design is likely to have contributed to selection bias. A randomised controlled trial (RCT) would have been a more robust design, however, there were practical reasons for the sequential cohort. Most importantly a RCT design may have resulted in health provider bias in so far as a treating physiotherapist could have been caring for participants randomised into different arms of the study; one participant receiving “usual care” and the other under the guidance of the ACE programme. In this scenario it would be difficult to ensure that health provider behaviour was independent. The only method of ensuring provider independence would be to have dedicated ACE programme health providers and to control all elements of care that were delivered to Intervention participants. It is feasible that if the study had been performed in a larger state it may have been possible to test the intervention in a RCT and, therefore, limit
health provider bias. In this study a RCT design in the setting of a contained demographic and single provider of CTP insurance claims management would have introduced other potential confounders.

7.5.2. Health measures

The addition of a three-month outcome measure may have been more sensitive to change in health status. It is reasonable to expect physical symptoms associated with normal course of recovery from soft tissue injuries to resolve within three months, so it would make sense to measure around this time-point. However, it should be recognised that any physical health changes at three months that were not carried forward to six and twelve months may be less important to the patient.

Secondly, it was not possible to assess pre-injury health or psychological status. Both of these factors are known confounders and are likely to influence the results (30, 35, 40). It is difficult to obtain a robust measure of pre-injury health status. Recall bias is a limitation in studies which rely on the participant’s subjective assessment(189). This is particularly relevant in the post-crash setting where symptom attribution may be important in the genesis of chronic injury. A more objective measure is pre-injury health utilisation data, which could be obtained from health agencies (Medicare Australia) and private health insurers.

7.5.3. Intervention design

The results of the study may have been different had it been possible to control all elements of treatment (for example, physiotherapy, chiropractic and GP care). However,
this approach was met with significant resistance from professional associations. There was a strong concern that managing care from within the study programme would disengage their members. So while this is a limitation of the study, the feedback informs policy makers of the likely requirement for extensive consultation with professional associations before any programmes that seek to manage care are considered.

Finally, participants may have benefited from a more intensive follow-up. A more frequent review of participants in the intervention programme would have enabled the clinical team to monitor recovery and reinforce key messages about pain management and mobilisation, and assess the effectiveness of treatments. In the research environment this was logistically very difficult to do, particularly in terms of staff resourcing. This suggests that incorporating the model into standard care may not be an economically viable option.

7.6. Implications

This research contributes to a better understanding of the way people recover from MSK injuries following RTCs. It highlights the high level of pain and disability that injured people experience in the post-crash setting, and reinforces the significant role of psychological factors in recovery. It raises a number of considerations for the health system, compensation scheme design and the insurance industry.

In terms of the health system, it is clear from this research that the ED is not the ideal setting for definitive post-crash care. The purpose of the ED attendance is to rule out life-
threatening injuries. The ED is perhaps not serving the person with non-catastrophic injuries sustained in road crashes efficiently, and internal processes within those departments could be modified. After an ED initial clinical assessment has ruled out life-threatening injuries, the injured person may benefit from clinical follow-up that is specific to the post-crash setting. Given that people report moderate levels of pain and disability in the week following the crash, on face value, there would seem to be value in reviewing injured people during this period in order to reinforce pain management and mobilisation strategies. Additionally, the review could incorporate screening for psychological risk factors such as anxiety, coping styles and emotional function. A structured treatment programme could be targeted at those most at risk of poor recovery, for example, people displaying moderate pain, high disability and high anxiety.

There are a number of considerations this research has raised for the compensation system and some of these are specific to the ACT CTP scheme. The first is to remove the barriers to accessing early medical treatment. Treatments delivered as soon as possible after the crash, are more likely to result in a favourable health outcome. However, a person may not be able to commence treatment if insurance cover is unclear or the claim is disputed. Measures that facilitate early and effective rehabilitation treatment should be applied when designing any compensation scheme. In fault-based schemes such measures include early claim notification incentives and allowing payments for medical treatments without the need to prove fault. Expediting payments for medical treatments should include those received at the crash (ambulance services) and in the ED.
Another consideration is to simplify the compensation process, and make it less threatening and intimidating for injured people to navigate. It is unclear why the process of lodging a claim for compensation needs to be so complex. Simplifying and making it more accessible may have the added benefit of minimising the need for lawyers to represent minor injury claimants, leading to both a reduction in costs and an improvement in health outcomes.

It follows that benefits could be gained from educating the public on the compensation schemes. Road users fund CTP schemes through payment of third party insurance, and that insurance is usually a component of car registration fees. If there was greater public awareness of the link between car registration fees, the cost of CTP insurance (for the policyholder) and the costs of operating CTP schemes, there may be greater debate on the merits of scheme design features.

Consideration should be given to different approaches to dispute resolution, particularly in determining the nature, extent and treatment of injuries. The adversarial nature of the common law process focuses each party on optimisation of claim settlement. Ongoing medico-legal assessment can take priority over treatment of injury. It is feasible that repeated medical examinations required for the purpose of litigation have a negative effect on the injured person.

Limiting access to compensation for 'pain and suffering' and other non-economic loss for minor injury claims should be considered. Compensation for the short-term pain and suffering associated with minor injury claims results in scarce resources being directed to less seriously injured crash victims. This arguably, is done at the expense of those people
who need them most; that is the seriously or catastrophically injured. Whether pain and suffering claims are restricted to specific injuries, or based on achieving a threshold for an overall level of impairment, restrictions should apply. The flow-on benefit of improving health outcome and reducing the number of small claims has been demonstrated in previous studies (19, 108). Additional expected benefits would be a reduction in costs due to fewer disputations, and earlier claim finalisations, resulting in both greater certainty and predictability of costs, and sustainability of the scheme.

Finally and most importantly, any modifications of compensation systems should be considered under the basic premise of treating all injured people with fairness and equity; a guiding principle in scheme design.

The research has raised a number of operational considerations for insurance companies managing RTC injury claims. Firstly, deal with the simple things that are causing most stress for the injured person, for example, replacing the damaged vehicle, providing alternative methods of transport and facilitating return to normal activities. It is expected that the injured person’s health may take several weeks to return to normal, but during this period there are practical things the insurer could initiate in order to reduce the stress associated with the crash. Reducing the injured person’s stress may lead to a faster recovery, which in turn may translate into lower costs for the insurer. An insurer may be able to facilitate this through a linkage between comprehensive vehicle and CTP lines of insurance. This may operate through a direct linkage of data (that is, a method that allows the comprehensive vehicle insurer to notify the CTP insurer of a potentially injured person), or by the comprehensive vehicle insurer acting as an agent for the CTP insurer.
and ensuring that claimants are aware of the process for lodging CTP claims. An improved line of communication between the CTP and comprehensive car insurers could assist in identifying needs and coordinating services for the injured person, lessening the stress associated with the crash.

Secondly, based on this research where it was shown that health status after mild to moderate injury had stabilised by six months post-crash, the insurer should actively work towards closing minor injury claims within this time period. For those claims that are not closed within this period, there is a case for the insurer to take a more active approach to claims management by re-evaluating treatment strategies and ensuring treatments are evidence-based and outcome focused. The insurer is funding the treatments, it is not unreasonable that it has a greater say in the number and types of therapies delivered.

7.7. Contribution

This research is the first to investigate, in an Australian setting, the effect of an early intervention assessment and treatment coordination programme for people with mild to moderate MSK injuries sustained in RTCs. While the early intervention programme did not show any benefit of an improved health outcome, it has offered considerable insight into the needs of the injured person in the early post-crash period. It reinforced the knowledge that psychological factors such as stress and anxiety are important contributors to health outcome. Additionally, it confirmed previous research which indicates a negative association between compensation and health outcome.
The research represents a significant contribution to understanding the needs of the injured person in the post-crash period from policy, health and compensation viewpoints.

7.8. Future Research

Future research should be directed at four areas. The first is in identifying the specific elements of a biopsychosocial model of care that can be effectively and efficiently implemented into the post-crash setting. This research has demonstrated that psychological factors play a significant role in recovery, and therefore, treatment strategies need to address these factors.

Additionally, the current research suggests that some people will respond to a self-management model, while others require a more intensive and supportive approach to care. The second area of research focus should be directed at clearly defining people at risk of poor outcome in order to screen and target those people with the greatest need. Defining those with the greatest need will allow resources to be directed appropriately.

Thirdly, future research in the ACT should be directed at investigating a managed care approach to treatment for people injured in RTCs. The aim would be to control all elements of health provider care and the services delivered, and to manage care according to clearly defined outcomes. This could take the form of a multidisciplinary approach to care, with emphasis on provider-to-provider collaboration. The current study was unable to direct care to specific health providers or fully coordinate services between providers.
Finally, an economic evaluation of the ACE programme is currently being performed. Utilising data from Medicare Australia, private health insurers, ACT Health and the CTP insurer, participant’s health resource utilisation will be established. This will reveal if there are economic advantages of the trialed model of care. It may also identify cost benefits for particular sub-groups of injured people (e.g. high disability, high anxiety).

7.9. Conclusion

This research adds to the body of knowledge on how people recover from crashes that have resulted in mild to moderate MSK injury. It contributes to a better understanding of the needs of injured people in the immediate post-crash period by highlighting the high level of pain and disability that people experience. The information relating to fault status enables a greater understanding of how fault influences response to injuries; this in turn informs the debate on the merits of fault-based compensation systems. The research supports previous evidence that the compensation system is associated with poorer health outcomes. While the intervention did not demonstrate a health benefit, the study has identified some components of a model of care design that would be useful to evaluate in future studies.
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Appendices

Appendix A Intervention programme

Appendix B Research Study forms

Appendix C Supporting data tables (Chapter 4 and 6)
Appendix A  Intervention programme

Appendix A describes the ACE intervention programme. It is set out in three sections. The first section describes the clinic intervention; the second section outlines the education programme and the final section contains samples of the educational support materials used in the programme.

Accident Care Evaluation Clinic Intervention

Patients attended the Accident Care Evaluation (ACE) clinic where they were reviewed by a musculoskeletal physician. In order to quantify and monitor progress, each patient was asked to complete a series of functional assessment tools. These included a Pain Localisation Body Chart, Numeric Pain Intensity Scale and injury specific tools (Neck Disability Index questionnaire; Oswestry Disability Questionnaire; Disabilities of the Arm, Shoulder and Hand Questionnaire; Hip and Knee Outcomes Questionnaire; or Foot and Ankle Outcomes Questionnaire). During assessment, the examining physician noted past medical history; regular medications; occupation, home domestic situation; injury history; treatments and investigations to date; current symptoms; results of functional assessment tools; and the patient's expectations in relation to their injury. The physician noted relevant features in the history such as catastrophisation, excessive anxiety or inappropriate attribution.

Physical examination was performed with particular emphasis on the presence or otherwise of protective posturing, excessive apprehension or abnormal illness behaviour.
Examination was evidence-based. In cases of whiplash associated disorder for example, examination utilised the Canadian C-spine Rules.

The patient was provided with a detailed explanation of the nature and likely natural progression of their condition. In most cases this involved an explanation of pain physiology using the aid of a PowerPoint presentation. A treatment plan was discussed. Treatment advice was provided in writing. Where appropriate, a simple home exercise program was prescribed. This included a range of rehabilitation exercises with specific written instruction. The exercise instruction sheets had step-by-step guidelines and digital photographs to assist with patient recall and exercise technique. The patient was also provided with written advice about any specific concerns related to protective posturing and the use of medication.

If indicated, medical imaging was arranged, followed by further clinical review. In addition, if the physician had concerns regarding excessive apprehension, anxiety, protective posturing or abnormal illness behaviour, arrangements were made to review the patient at the clinic two weeks after the initial consultation. The physician considered referral for specialised psychological support if the patient demonstrated ongoing maladaptive behaviour at follow up.

If no clinic follow-up was deemed necessary, the physician made arrangements for the nurse educator to telephone the patient two weeks after the consultation to check that there had been satisfactory clinical progress. The nurse educator asked standardised questions relating to use of analgesics, use of medical services, symptom levels and return to normal activities of daily living. If the patient was making satisfactory clinical progress,
encouragement and clarification was provided. If the nurse educator had concerns about the patient at the two-week follow-up telephone call, these concerns were referred to the clinic physician. The physician arranged to review the patient at the clinic, or speak with the patient over the telephone.

Further telephone contact was made at three months to assess clinical progress. Patients were asked a standardised series of questions and any concerns were relayed to the physician. Patients were discharged from the clinic if they met the following criteria:

- No requirement for regular outpatient medical services
- No requirement for regular analgesia
- Resumption of normal daily activities of living
- Return to normal work activities

If the patient did not satisfy the criteria for discharge, the clinic physician was notified. The physician assessed the patient via telephone and a further consultation was arranged, if required. Patients requiring ongoing assistance beyond four months were encouraged to remain under the care of their usual medical provider.

**The Education Programme**

The ACE education programme was developed to support the intervention phase of the ACE study. The objective of the programme was to provide evidence-based best practice guidelines on the assessment and management of soft tissue injuries sustained in a road
traffic crash (RTC). The programme, was delivered in a number of formats, and was
targeted at those injured in the crash and their treating healthcare professionals.

Materials were developed for healthcare professionals, the injured person and their
family, and aimed to assist them to better understand their injury and recovery pathway.

The key educational objectives of the program were to:

- Improve patient and healthcare provider knowledge and understanding
- Facilitate positive recovery expectations for patients
- Provide patients with reassurance and confidence
- Improve overall health outcomes for injured people

Educational resources

The “Information and Resources for Health Care Professionals” brochure was developed
specifically for health professionals, and aimed to introduce the ACE study, its design and
objectives. Additionally, it encouraged health professionals to seek out treatment
protocols outlining best practice injury management for shoulders, hips, knees, lumbar
spine, and neck. Sample treatment protocols were included in the brochure and all were
available as downloadable PDF files on the ACE website.

The brochure was mailed to all general practitioners (GPs) in the Australian Capital
Territory (ACT), physiotherapists and specialist physicians prior to the commencement of
the intervention arm of the Study. The accompanying letter from the study Chief
Investigator invited healthcare professionals to visit the ACE website where they could
access detailed information relating to the management of soft tissue injuries following RTCs.

Additionally, the brochure was utilised at the ACE study education sessions provided for Emergency Department (ED) staff and GPs. The brochure also accompanied any medical report from the ACE clinic to the treating healthcare professional of intervention patients.

The “Fast Road to Recovery” booklet was designed both as a tool for the general public, in particular those involved in RTCs, and as a supporting resource for healthcare professionals to provide their patients. The booklet covered information on healing, pain, types of injury and area-specific exercises for soft tissue injury following involvement in RTCs. While the booklet specifically aimed to reinforce information and treatment provided at the ACE clinic, it also acted as a resource for both patients and healthcare professionals in the primary health care setting. The booklet was given to all intervention patients by the nurse educator, and was also available on the website for access by healthcare professionals.

Following the clinic assessment, patients were provided with rehabilitation exercises to perform at home. To assist with recall, the exercise program was provided as a handout, targeting specific body regions relevant to the patient’s injury. It included detailed written instruction, supported with digital photographs to show correct technique.

**Health Provider Education Sessions**

To meet the intervention objectives of promoting the use of evidenced based treatments for people injured in RTCs, through education to the broader healthcare community,
specific education sessions were developed for healthcare professionals who provide primary care for the RTC patient.

A number of PowerPoint education presentations were developed for this audience. The sessions were delivered by the ACE Medical Director and nurse educator, and topics included:

The Whiplash Associated Disorder (WAD) presentation;

“Crash Course” : management of musculoskeletal injuries following crashes;

The ‘Pain-Dysfunction Cycle’, and

The ACE Study presentation

The Whiplash Associated Disorder (WAD) PowerPoint presentation provided an evidence based definition, diagnosis and treatment of WAD, together with a summary of the ‘pain-dysfunction cycle’. These were presented by the Medical Director as “Whiplash Updates” and were provided for ED medical staff at both The Canberra Hospital and Calvary Hospital on six occasions over 18 months. Sessions were repeated to accommodate the rotation of resident and registrar medical staff. The nurse educator supported the sessions and provided ACE study pamphlets to familiarise the audience with the ACE website and treatment protocols, as well as summary notes of the presentation.

The “Crash Course” was a two-part PowerPoint presentation developed to provide GPs with an opportunity to update their knowledge and skills, whilst obtaining Continuing Professional Development (CPD) points facilitated through the ACT Division of General Practitioners. These courses presented by the Medical Director, were offered over two
consecutive weeks, and were delivered at two separate locations to maximise attendance and exposure to the ACE study. Each course was repeated twice at each location throughout the intervention stage of the Study.

The "Crash Course" gave a broad synopsis of RTC injury management for GPs. It provided detailed practical information covering WAD, the 'pain-dysfunction cycle', and the relationship between compensable medicine and health outcomes, utilising evidenced based medicine. Several case studies were given in the Crash Course to further enhance the understanding of the material presented. The course had an interactive structure which allowed GPs to move through a decision-making process while discussing and applying evidence-based management protocols. Course participants were provided with supporting material which included the ACE study awareness brochures, "Fast Road to Recovery" patient information booklet and "Information for Health Professionals" brochure.

Each Crash Course participant completed a formal course evaluation at the end of the presentation. This formal evaluation contributed towards the allocation of CPD points.

The Crash Course was also available on the ACE study website. Health professionals who were unable to attend the organised sessions could complete the course online and qualify for CPD points.

The "Pain-Dysfunction Cycle" PowerPoint presentation was used by the Medical Director for education of both the intervention participants and to demonstrate to healthcare professionals the method of treatment and education that was provided for each patient.
The presentation described in layman’s terms how non-physical factors such as expectation, fear, anxiety and stress may contribute to symptoms following RTC. It also explained how certain maladaptive behaviours such as excessive protective posturing can amplify symptoms. A printed flow diagram of the pain-dysfunction cycle was given to each participant.

The ACE study presentation provided an overview of the study; it included the study hypothesis, rationale, study end points, and description of the study intervention. This presentation was utilised and adapted by the Medical Director, nurse educator, and research coordinator for different audiences, including ED staff, GPs, practice nurses, insurance industry representatives and stakeholder groups.

**ACE Study Website**

The ACE study website was a learning resource for intervention participants, healthcare professionals and the general public. It was an interactive tool, divided into two areas, the first targeting injured people and the second focussing on the healthcare professionals. The unrestricted access section of the website aimed to support injured people and the general public with general lifestyle hints, stories from people injured in RTCs, and recovery expectations. Healthcare professionals who registered on the site were granted access to literature reviews, lecture kits (Best Practice Injury Management, Managing Patients in a Compensable Environment), treatment protocol algorithms and opinion polls.

At the initial clinic assessment appointment each intervention participant was given a ‘tour’ of the website by the nurse educator. This allowed the participant to seek further
information and reassurance after their consultation with the Medical Director at the
clinic.

**Stakeholder Management Program**

Commencement of the intervention phase of the study was announced to the local
community at a public launch. Local print, radio and television media attended the launch
along with representatives from government, legal professional societies, healthcare
groups and insurance industry. In addition, articles were placed in professional
publications targeting GPs, physiotherapists and legal providers.

To limit bias, all awareness programmes and training for healthcare professionals
commenced at the completion of control group recruitment and continued throughout
the intervention recruitment.

**ACE Study Support Materials**

The following section contains the support materials used throughout the ACE study.

They are grouped according to their target audience.

**Patient Education**

- Fast Road to Recovery booklet
- Pain dysfunction cycle slide presentation
- Exercise programs

**General Practitioner and allied health education**

- Treatment protocols
  - Whiplash Associated Disorder
- Acute lumbar spine injury
- Shoulder injury
- Hip injury
- Knee injury
- Foot and ankle injury
- General practitioner education presentations
  - Online healthcare provider education presentations
  - General practitioner “Crash Course” presentations

**Study awareness / recruitment**

- Patient information poster
- Patient information brochure
- Healthcare professional brochure
- Awareness / treatment protocol wall chart

All educational materials were developed specifically for the ACE Study and have been reproduced with the permission of the ACE Study Group.
The fast road to recovery

Tips for healing quickly from minor motor vehicle accident injuries
Contents

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How to use this guide

You have been given this booklet because you have suffered a minor injury (such as bruising, whiplash, or strained or torn muscles, ligaments or tendons) in a motor vehicle accident.

This booklet provides information, advice, and examples of exercises that will help to maximise your recovery so you can go back to your normal activities at home, work or school, as soon as possible.

The first section of this booklet - ‘What to expect as you heal’ - outlines some of the physical and emotional changes you may undergo as you recover.

The booklet is then divided into five main injury areas - neck, lower back, shoulder, knee/ankle, and hip. Your doctor will refer you to the section or sections that apply to you.
What to expect as you heal

Physical changes to expect

Healing occurs in three main stages, which are described in the diagram below.

1. Inflammation:
The injured tissue becomes painful, stiff, swollen, warm and red. Special cells and other chemicals are released to fight any bacteria and generally 'clean up' the injured area.

2. Repair:
Scar tissue begins to form.

3. Remodelling:
The tissue is 'rebuilt' so it matches its original state as much as possible.

- The greater the blood supply to the tissue that has been injured, the faster it tends to heal.
- Most of the pain you experience as a result of your injury should subside as the tissue heals (see the black line on the diagram).
- Pain can sometimes persist beyond this time due to other factors, such as nerve damage (see the dotted line on the diagram). Pain is discussed in greater detail on pages 6-7.
Managing muscle and joint strains

The R.I.C.E. method can be used to minimise the swelling and pain you experience as a result of your injury. This method involves:

Rest

For about 48 hours after your injury you should rest the injured area. If you have injured your leg it might be necessary to stay off your feet; otherwise, just avoid stretching or jointing the injured area.

*Important note:* After the first 48 hours you should try to resume your normal activities as much as possible. Staying active will help your recovery.

Ice

Starting as soon as possible after your injury, apply a cold compress to the injured area for about 15-20 minutes, and then remove it (the ice will damage your skin if you leave it on for too long). Repeat this every 4 hours while you are awake, for the next 48 hours. You can buy a cold pack from a pharmacy, or make your own cold compress using a bag of frozen peas or some crushed ice cubes wrapped in a wet tea towel.

Compression

Wrap a firm crepe or elastic pressure bandage over the area.

Elevation

If possible, prop the injured area up so it is resting above the level of your heart.
Dealing with pain

Lots of physical and emotional factors contribute the pain you feel after an injury. If these factors are not dealt with quickly they can feed off each other, creating a ‘pain cycle’ like the one described in the diagram below.

The best way to avoid getting stuck in the ‘pain cycle’ is to stay active in the weeks following your injury. This will help maintain the strength and flexibility of your muscles. Taking a simple pain relief medication (such as paracetamol) may also help to manage your pain in the first few days after you are injured and allow you to stay active. Taking strong pain relief medication is generally not helpful.

The ‘pain cycle’

- Anger at those to blame
- Tissue damage
- Fear of re-injury
- Emotional or financial stress (related to injury)
- Decreased shock absorption, loss of joint control
- Increased sensitivity of pain receptors
- Protective posturing
- Muscle wasting

- Being injured can trigger emotions like anger, fear, and stress which can make you more sensitive to painful stimuli.
- Fear of being re-injured can lead to ‘protective posturing’ – holding any part of the body still to protect it, when the body part would otherwise be moving normally. Limping because of a painful ankle is an example of protective posturing.
- Protective posturing causes muscle wasting and joint stiffness, and increases the sensitivity of pain receptors, making pain worse.
- Pain causes muscle wasting in the vicinity of the pain. Muscles are then less able to act as shock absorbers and to control the movement of our joints (which adds to the pain)

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Tips for dealing with pain

- Return to work and normal activities straight away (or as soon as your doctor says you are ready);
- Gently exercise the injured area;
- Keep moving the injured area in a natural manner (avoid protective posturing);
- Talk to your doctor if you think that emotions like stress or fear are affecting your recovery.

What else might happen?

The following are some quite normal responses to an accident such as a car accident:

- Feelings can become intense and unpredictable
- You might have repeated and vivid memories of the accident
- You may feel emotional when reminded of the accident (for example the sounds of sirens can trigger upsetting memories)
- Relationships with co-workers, friends and family may become strained
- If you are very emotionally stressed, you may also experience physical symptoms such as headaches, nausea or chest pain.
What else might happen?

Tips for coping

There are a number of steps you can take to help restore your sense of well-being and control following a motor vehicle accident or other traumatic experience:

• Be patient and give yourself time to heal.
• Ask for support from people who care about you.
• Communicate your experience in whatever ways feel comfortable to you - such as by talking with family or close friends, or keeping a journal.
• Engage in healthy behaviour – eat well-balanced meals, exercise, and get plenty of rest. If you experience ongoing difficulties with sleep, you may be able to find some relief through relaxation techniques.
• Avoid alcohol or drugs.
• Establish or re-establish routines such as eating meals at regular times and following an exercise program.
• Take some time off the demands of daily life by pursuing hobbies or other enjoyable activities.
• If possible, avoid making major life decisions such as switching careers or jobs because these activities tend to be highly stressful.
• Become knowledgeable about what to expect as a result of your accident.

If your problems persist and are disrupting your daily life, talk to your GP or consult a mental health professional.
Neck (whiplash associated disorder)

What is whiplash associated disorder?

'Whiplash' occurs when there is a sudden back and forth movement of the head and neck. 'Whiplash associated disorder' (WAD) refers to any neck injury that is caused by whiplash. Motor vehicle accidents are a very common cause of WAD. The vast majority of cases of WAD will get better without causing any permanent health problem or disability.

What are the symptoms of WAD?

Neck pain and stiffness are the most common symptoms of WAD. In some cases there may also be headache, weakness or pain in the shoulders or arms, and/or dizziness or altered sensation.

How is WAD treated?

WAD should be assessed by a doctor as soon as possible to check that there is no fracture, dislocation, or other serious damage to your neck.

In the majority of cases there will not be any serious injury.

Treatment of WAD usually involves staying active and moving your neck normally, and doing some simple neck exercises every day. Sometimes it is helpful to see a physiotherapist.

What if I am in pain?

Even if you are in pain, you should stay active and do the exercises recommended by your doctor, physiotherapist, or other health professional. Simple pain killers (such as paracetamol) may help to manage your pain initially. Taking strong pain relief is generally not necessary or helpful.

Will resting in bed or wearing a collar help my recovery?

No! In fact, there is evidence that this will make your symptoms worse. But you should avoid activities that involve sudden or jerky movements.
Neck injury continued

What will help my recovery?

Daily performance of specific exercises for your neck combined with treatment from a physiotherapist can improve your outcome.

It is also important to realise that pain can be increased by factors such as fear, anger, frustration, or financial, psychological or emotional stress. If any of these factors are troubling you, tell your doctor. In such cases counselling from a qualified psychologist can be helpful.

How soon will I recover?

Recovery times vary from person to person. Most patients with WAD can return to work and normal activities immediately. This means it is safe for you to return to work or school and your normal social activities even if you are still having some neck pain.

Remember…

✓ Stay active – keep moving your neck as normally as possible
✓ Do not wear a neck collar - it is not necessary, and may be harmful
✓ In most cases WAD is not serious and will get better with no permanent effects
✓ Perform your neck exercises every day
✓ Don’t worry if the exercises are uncomfortable to begin with – this does not mean they are causing harm
✓ Stay positive and relaxed – be aware of when you are stressed or worried and do something about it
✓ It is safe for you to go back to work or school and other activities even if you still have some neck pain
Some exercises to get you started

1. Neck exercise
   - Gently move your neck in six directions
     - Forward
     - Backward
     - Rotate left
     - Rotate right
     - Tilt left
     - Tilt right
   - Repeat three times

2. Chin tucks
   - Look straight ahead
   - Keep chin level
   - ‘Slide’ head backwards
   - Hold for 5 seconds
   - Repeat 5 times

3. Head lifts
   - Lie flat
   - Lift your head, just a few centimetres
   - Pause, lower your head back to the resting position
   - Repeat 10 times in 4 directions (A,B,C)

Ask your doctor, nurse educator, or physiotherapist for more information about the best exercises for you.
Shoulder injury

What are the most common types of shoulder injury?
Most shoulder injuries involve one of the following:
- a sprain or tear to the muscles, ligaments or tendons that hold the shoulder bones in place;
- injury to the tissues that help lubricate the shoulder joints;
- instability (partial or full dislocation) of the shoulder joint.

These injuries can cause pain (especially when you move or flex your shoulder), swelling, shoulder stiffness, weakness, or a feeling that the shoulder is sliding or popping out of its socket.

How is a shoulder injury treated?
Your injury should be assessed by a doctor as soon as possible to check that there is no fracture or other serious damage to your shoulder. Treatment then usually involves staying active, doing some simple shoulder exercises, and moving your shoulder as normally as possible.

What if I am in pain?
Even if you are in pain, you should stay active and do the exercises recommended by your doctor, physiotherapist, or other health professional. While the shoulder pain may be unpleasant, it does not mean that you are making things worse. Simple pain killers (such as paracetamol) may help to manage your pain initially. Taking strong pain relief is generally not necessary or helpful. In some cases, your doctor may recommend that you have a corticosteroid injection into your shoulder. This can improve your pain for several weeks, and allow you to continue your strengthening exercises.

What will help my recovery?
Staying active is the key to a fast recovery! It has been shown that early return to normal work and social activities improves the outcome in shoulder injury. It is also important to realise that pain can be increased by factors such as fear, anger, frustration, or financial, psychological or emotional stress. If any of these factors are troubling you, tell your doctor. In such cases counselling from a qualified psychologist can be helpful.

How soon will I recover?
Most patients with a minor shoulder injury can return to work and normal activities immediately. This means it is safe for you to return to work or school and your normal social activities even if you are still having some shoulder pain.
Remember...

☑ Stay active

☑ In most cases, shoulder injuries are not serious and will get better with no permanent effects.

☑ Perform your shoulder exercises every day.

☑ Don't worry if the exercises are uncomfortable to begin with - this does not mean they are causing harm.

☑ Stay positive and relaxed - be aware of when you are stressed or worried and do something about it.

☑ It is safe for you to go back to work or school and other activities even if you still have some shoulder pain.
Shoulder injury continued

Some exercises to get you started

1. Shoulder exercise
   - Sit on edge of table
   - Arms crossed over chest
   - Rotate trunk as far as possible in one direction, and then rotate in the other direction
   - Repeat 10 times on each side

2. Shoulder exercise
   - Pinch shoulder blades together
   - Hold for 10 seconds
   - Repeat 5 times

3. Shoulder exercise
   - Sitting position
   - Arm by the side with elbow flexed to 90°
   - Squeeze cushion between elbow and side of chest
   - Hold for 10 seconds
   - Repeat 5 times

Ask your doctor, nurse educator, or physiotherapist for more information about the best exercises for you.
Lower back injury

What is a lower back injury?

Lower back injuries usually involve a sprain, strain, or tear of the back muscles or ligaments, or an injury to joints or discs. Your doctor can provide you with more information about the nature of your injury. A lower back injury usually causes pain and tenderness in the area of the injury, but may also cause pain or numbness in the buttocks, groin, or legs (this is called “referred” pain).

How is a lower back injury treated?

Lower back pain after a motor vehicle accident is common, and in the vast majority of cases the pain gets better without causing any permanent disability. However, your injury should be assessed by a doctor as soon as possible to check that there is no serious damage to your back. Treatment then usually involves staying active and performing specific exercises for your back. Treatment from a physiotherapist can also be helpful.

What if I am in pain?

Even if you are in pain, you should stay active and do the exercises recommended by your doctor, physiotherapist, or other health professional. Simple pain killers (such as paracetamol) may help to manage your pain initially. Taking strong pain relief is generally not necessary or helpful. It is also important to realise that pain can be increased by factors such as fear, anger, frustration, or financial, psychological or emotional stress. If any of these factors are troubling you, tell your doctor, in such cases counselling from a qualified psychologist can be helpful.

What will help my recovery?

Staying active is the key to a fast recovery! It has been shown that early return to normal work and social activities improves the outcome in back injury. Consciously moving your back in a normal way improves the outcome, even if moving initially causes discomfort. Holding your back still to avoid discomfort will make your symptoms worse.

How soon will I recover?

Recovery times vary from person to person, but most of the time lower back pain will get better in several weeks. Back pain can return over time, but this does not mean there has been a re-injury.
Lower back injury continued

Remember…

- Stay active
- In most cases, lower back injuries are not serious and will get better with no permanent effects
- Perform your back exercises every day
- Stay positive and relaxed – be aware of when you are stressed or worried and do something about it
- Don’t worry if the exercises are uncomfortable to begin with – this does not mean they are causing harm
- It is safe for you to go back to work or school and other activities even if you still have some back pain

Some exercises to get you started

1. **Lumbar exercise**
   - Lie on your back
   - Pull knee to chest
   - Hold for 20 seconds
   - Repeat 3 times

2. **Lumbar exercise**
   - Lie on your back
   - Hold thigh at 90° and gently straighten your knee until you feel a stretch down the back of your leg
   - Hold for 20 seconds
   - Repeat 3 times
3. Lumbar exercise
   • Lie face down
   • Pull ankle into buttock
   • Feel stretch down front of thigh
   • Hold for 20 seconds
   • Repeat 3 times

4. Lumbar exercise
   • Lumbar stretch
   • Relax lower back
   • Hold for 20 seconds
   • Repeat 3 times

5. Lumbar exercise
   • Lie face down
   • Rest on elbows
   • Relax lower back
   • Hold for 20 seconds
   • Repeat 3 times

6. Lumbar exercise
   • Lie on back
   • Knees bent
   • Arms out to side
   • Gently rock knees from side to side
   • Repeat for 1 minute

Ask your doctor, nurse educator, or physiotherapist for more information about the best exercises for you.
Lower limb injury

What is a lower limb injury?
A lower limb injury is one that affects the leg - especially the knee, foot or ankle. Injuries to the lower limb are common after a motor vehicle accident. Most of these injuries are not serious and do not involve important structures within the knee, foot or ankle. They simply indicate bruising, strains or sprains.

How is a lower limb injury treated?
Your doctor will first perform a thorough physical examination. If you are able to walk normally, and you can walk on your toes, then it is unlikely that you have suffered a significant structural injury to the knee, foot or ankle. Your doctor will perform other investigations such as x-rays or scans, if they suspect that there is a more serious injury present. Treatment then usually involves staying active and performing specific exercises to help strengthen the limb that has been affected. Treatment from a physiotherapist can also be helpful.

What if I am in pain?
Even if you are in pain, you should stay active and do the exercises recommended by your doctor, physiotherapist, or other health professional. While the pain in your knee, foot or ankle may be unpleasant, it does not mean that you are doing harm. Simple painkillers (such as paracetamol) may help to manage your pain initially. Taking strong pain relief is generally not necessary or helpful. If your foot, knee or ankle is stiff and uncomfortable first thing in the morning, it can also help to warm up the joint for about one minute before you step out of bed.

What will help my recovery?
You can help speed up your recovery by sticking to your exercise regimen and using your leg normally. Limping is a normal response to discomfort anywhere in the lower limb, but your pain will settle much more quickly if you can try to walk as normally as possible. It is also important to realise that pain can be increased by factors such as fear, anger, frustration, or financial, psychological or emotional stress. If any of these factors are troubling you, tell your doctor. In such cases counselling from a qualified psychologist can be helpful.

How soon will I recover?
Most patients with a lower limb injury can return to work and normal activities immediately. This means it is safe for you to return to work or school and your normal social activities even if you are still experiencing some pain.
Remember...

- Stay active
- In most cases, injuries to the lower limb are not serious and will get better with no permanent effects
- Perform your knee, foot, or ankle exercises every day
- Stay positive and relaxed – be aware of when you are stressed or worried and do something about it
- Don’t worry if the exercises are uncomfortable to begin with – this does not mean they are causing harm
- It is safe for you to go back to work or school and other activities even if you still have some pain in your leg
Lower limb injury continued

Some exercises to get you started

A. Knee exercise
- Lie on your back
- Keeping your knee straight, gently lift your leg 30 cm off the floor, pause and lower your leg to the resting position
- Repeat 10 times

B. Knee exercise
- Sit on edge of table with lower leg hanging down in resting position
- Straighten knee and hold for 5 seconds, before returning to resting position
- Repeat 5 times

2. Ankle exercise: flexion and extension
Point your foot downwards away from you by bending your ankle. Relax then pull your foot up towards you.

Ask your doctor, nurse educator, or physiotherapist for more information about the best exercises for you.
Hip injury

What is a hip injury?
Hip injury following a motor vehicle accident is usually due to a strain, sprain or bruise to the muscles, tendons or ligaments around the hip, rather than injury to the hip joint itself. It will resolve, without causing any permanent incapacity or disability, in the vast majority of cases. Hip injury can be associated with symptoms such as:

- Muscle stiffness
- Limping
- Pain in the hip joint or groin
- Pain that radiates to the thigh and knee
- Reduced range of motion of the hip joint
- Pain when trying to put weight on the injured side of the body

How is a hip injury treated?
Your doctor will first assess you thoroughly to check that there is no serious structural damage to your hip. This sometimes, but not always, involves taking an X-ray or other type of scan. If there is a serious injury, such as dislocation of your hip joint, your doctor will refer you to an orthopaedic specialist. Minor hip injuries can be treated by gentle stretching and strengthening exercises, combined with treatment from a physiotherapist.

What if I am in pain?
Even if you are in pain, you should stay active and do the exercises recommended by your doctor, physiotherapist, or other health professional. While the hip pain may be unpleasant, it does not mean that you are doing harm. Simple pain killers (such as paracetamol) may help to manage your pain initially. Taking strong pain relief is generally not necessary or helpful. It is also important to realise that pain can be increased by factors such as fear, anger, frustration, or financial, psychological or emotional stress. If any of these factors are troubling you, tell your doctor. In such cases counselling from a qualified psychologist can be helpful.

What will help my recovery?
Staying active is the key to a fast recovery! You can help speed up your recovery by performing your hip exercises every day, and by returning to your usual work and social activities as soon as possible. It is also important to try to walk as normally as possible. Limping excessively will make your symptoms worse.

How soon will I recover?
Most patients with a hip injury can return to work and normal activities immediately. This means it is safe for you to return to work or school and your normal social activities even if you are still experiencing some pain.
Hip injury continued

Remember...

✓ Stay active
✓ In most cases, hip injuries are not serious and will get better with no permanent effects
✓ Perform your hip exercises every day
✓ Stay positive and relaxed – be aware of when you are stressed or worried and do something about it
✓ Don’t worry if the exercises are uncomfortable to begin with – this does not mean they are causing harm
✓ It is safe for you to go back to work or school and other activities even if you still have some pain in your hip
Some exercises to get you started

1. Hip exercise
   - Lie on your back
   - Pull knee to chest
   - Hold for 20 seconds
   - Repeat 3 times

2. Hip exercise
   - Lie on your back
   - Keeping your knee straight, gently lift your leg 30 cm of the floor, pause and lower your leg to the resting position
   - Repeat 10 times

3. Hip exercise
   - Lie on side with knees straight
   - Gently lift leg straight sideways
   - Return to resting position
   - Repeat 5 times

4. Hip exercise
   - Lie on side with knees bent
   - Leave ankles together and gently lift the upper knee
   - Return to resting position
   - Repeat 5 times

Ask your doctor, nurse educator, or physiotherapist for more information about the best exercises for you.
PowerPoint presentation covering the concepts of pain physiology, the relationship between pain and muscle activity, pain modulation and non-physical contributors to pain experience.

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NECK REHABILITATION PROGRAM

NAME: ____________________________

1. Gently move your neck in six directions
   - Forward
   - Backward
   - Rotate left
   - Rotate right
   - Tilt left
   - Tilt right
   - Repeat three times

2. Chin tucks
   - Look straight ahead
   - Keep chin level
   - 'Slide' head backwards
   - Hold for 5 seconds
   - Repeat 5 times

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3. Head lifts
   - Lie flat
   - Lift your head, just a few centimetres
   - Pause, lower your head back to the resting position

   - Repeat 10 times in 4 directions
     - Lying on your back
     - Lying face down
     - Lying on each side

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LUMBAR REHABILITATION PROGRAM

NAME: __________________________

1. Lie on your back
   - Pull knee to chest
   - Hold for 20 seconds
   - Repeat 3 times

2. Lie on your back
   - Hold thigh at 90° and gently straighten your knee until you feel a stretch down the back of your leg
   - Hold for 20 seconds
   - Repeat 3 times

3. Lie face down
   - Pull ankle into buttock
   - Feel stretch down front of thigh
   - Hold for 20 seconds
   - Repeat 3 times

4. Lumbar stretch
   - Relax lower back
   - Hold for 20 seconds
   - Repeat 3 times

5. Lie face down
   - Rest on elbows
   - Relax lower back
   - Hold for 20 seconds
   - Repeat 3 times

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6. Lie on back
   - Knees bent
   - Arms out to side
   - Gently rock knees from side to side
   - Repeat for 1 minute

7. Tummy Strengthening
   - Lie on back, knees bent
   - Fingertips on tummy
   - Lift head, just off floor
   - Tense tummy muscles (feel them tense with your fingertips)
   - 10 x 10 sec (20 sec, 30 sec)

8. Back strengthening
   - Lie face down
   - Arms stretched out over head
   - Lift one arm and opposite leg, just off floor
   - Hold 5 x 5 sec (10 sec)

9. Long acting paracetamol
   (Panadol Osten, Panadol Extend, Duratrol or similar)
   - 2 tablets
   - 3 times daily for 2 weeks
   - Thereafter in 3-day bursts, at times of exacerbation

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SHOULDER REHABILITATION EXERCISES

NAME: ____________________________

1. Sit on edge of table
   - Arms across chest
   - Rotate as far as possible each side
   - Repeat 20 times each side

2. Squeeze shoulder blades together and down
   - Hold for 10 seconds
   - Repeat 10 times

3. Squeeze pillow between elbow and side of chest
   - Hold for 10 seconds
   - Repeat 10 times

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- 'Superman' exercise
- Lie face down
- Lift chest off bed
- Squeeze shoulder blades together 10 seconds
- Repeat 10 times
- Push ups against wall
- Hold shoulder blades together
- Repeat 10 times

6a

- Elbow by the side
- Elbow flexed to 90°
- Push hand *inward* against the door frame
- Hold for five seconds
- Repeat five times

6b

- Elbow by the side
- Elbow flexed to 90°
- Push hand *outward* against the door frame
- Hold for five seconds
- Repeat five times

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6c
- Elbow by the side
- Elbow flexed to 90°
- Push *elbow outwards* against the door frame
- Hold for five seconds
- Repeat five times
HIP REHABILITATION PROGRAM

NAME: ____________________________

1. Lie on back
   - Pull knee to chest
   - Hold for 20 seconds
   - Repeat 3 times

2. Lie on back
   - Pull knee to opposite armpit
   - Hold for 20 seconds
   - Repeat 3 times

3. Lie on back
   - Hold thigh at 90°
   - Straighten knee until you feel tightness behind the knee
   - Hold for 20 seconds
   - Repeat 3 times

4. Lie face down
   - Pull heel to buttock
   - Hold for 20 seconds
   - Repeat 3 times

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5. Lie on side
   - Knees straight
   - 'Scissors' exercise
   - 5 lifts
   - Repeat 1 - 5 times

6. Lie on side
   - Knees bent
   - 'Clam' exercise
   - 5 lifts
   - Repeat 1 - 5 times

7. Lie on back
   - Ball between knees
   - Squeeze ball with knees
   - Hold for 5 seconds
   - Repeat five times
   - Follow this procedure with the knees at 0°, 30° and 90° of flexion
8. Stand in front of mirror
   8. Stand on one leg
   8. Bend the knee until it reaches the end of your big toe
   8. Hold belt-line horizontal
   8. Hold for 10 seconds
   8. Repeat 10 times

9. Tie theraband around leg of lounge
   9. Other end around ankle
   9. Keep knee straight at all times
   9. Slowly (and without jerking) move the hip against the theraband
   9. Repeat 10 times, in 4 directions
   9. Repeat for both legs
KNEE REHABILITATION PROGRAM

NAME: ____________________________

1. Lie on your back
   - Pull knee to chest
   - Hold for 20 seconds
   - Repeat 3 times

2. Lie on your back
   - Hold thigh at 90° and gently straighten your knee until you feel a stretch down the back of your leg
   - Hold for 20 seconds
   - Repeat 3 times

3. Lie face down
   - Pull ankle into buttock
   - Feel stretch down front of thigh
   - Hold for 20 seconds
   - Repeat 3 times

   - Lie on back
     - Pillow behind knee
     - Foot turned outwards
     - Toes up.....

   - Straighten knee and hold muscles hard for 10 slow seconds
   - Foot remains turned outward
   - Repeat 10 times

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5  • Knee straight, muscles hard  
   • Toes up  
   • Foot turned outwards  
   • Lift leg 5 cm off the floor and do five small circles (whole leg) in a clockwise direction  
   • Have a rest  
   • Lift leg 5 cm off the floor and do five small circles (whole leg) in an anticlockwise direction  
   • Repeat 5 times

6  • Stand on one leg  
   • Slowly bend the knee until the kneecap is in line with the tip of the big toe  
   • Tense the thigh muscles  
   • Hold 10 slow seconds and repeat 10 times

7  Repeat first three stretches, once only

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ANKLE REHABILITATION PROGRAM

NAME: ______________________

1. Gently move your ankle up and down and in a circular fashion
   • Repeat for 2 minutes

2. Stretch calf muscles, keeping knees straight
   • Hold for 20 seconds
   • Repeat 3 times

3. Stretch calf muscles, with knees bent
   • Hold for 20 seconds
   • Repeat 3 times

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4. Slowly stand up on toes
   - Pause
   - Slowly return to resting position
   - Repeat 10 times

5. Sit in chair
   - Rubber band around forefeet
   - Feet 15 cm apart
   - Knees and heels don't move
   - Push outwards against rubber band with forefeet
   - Repeat 20 times

6. Stand on one leg, knee slightly bent
   - Arms out to side
   - Look straight ahead
   - Get balance
   - 2 minutes
**PATIENT FORMS**

- Patient information sheet
- Neck Disability Index Questionnaire
- Pain localisation body chart
- Visual analogue scale

**HISTORY**

Areas to focus on:
- Prior medical history, regular medication, allergies
- Pain severity, neck mobility, neurological symptoms
- Prior history of neck injury or chronic pain conditions
- Presence or otherwise of negative mood, social withdrawal
- Presence or otherwise of excessive / unrealistic anxiety in relation to injury
- Symptoms of headache or head injury, prior to accident

**PHYSICAL EXAMINATION**

Areas to focus on:
- Cervical range of motion
- Peripheral nervous system examination
- Central nervous system examination
- Palpation for tenderness around the neck region
- Presence of protective posturing

**INVESTIGATIONS**

<table>
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<tr>
<th>Investigations</th>
<th>Indications</th>
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<tbody>
<tr>
<td>Plain radiography</td>
<td>Age &gt; = 65 years; High-speed (&gt;100 km per hour) MV accident, MV rollover, ejection of passenger from MV; Significant pain from another site; Neurological symptoms or signs, or suspected fracture or dislocation; Suspected fracture (and plain films are positive, suspicious or inadequate); Persistent pain; Pain or tenderness in the sub-occipital region</td>
</tr>
<tr>
<td>CT scanning</td>
<td>Acute neck pain in association with neurological deficit or suspicion of cord injury</td>
</tr>
</tbody>
</table>

*MV = motor vehicle*

**MANAGEMENT**

- Provide a clear treatment plan (timeframes, medications, work restrictions, general activity restrictions and basic rehabilitation exercise regimes)
- Provide necessary referrals to appropriate ancillary health care providers
- Encourage normal movement of neck
- Encourage early return to normal work and social activities
- If Yellow Flags* are present consider more intensive treatment or earlier referral

*See next page for list of Red and Yellow Flags*
Recommended interventions | Review | When to refer |
---|---|---|
- Advice to stay active  
- Reassurance and education  
- Gentle neck exercises  
- Multi-modal treatments inclusive of cervical passive mobilisation, in combination with specific exercise alone or specific exercise with other modalities | Review as necessary | If there is not functional and symptomatic improvement within a few weeks reassess and consider manual and physical therapies or seek specialist advice |

MAIN MESSAGES

Discourage:
- Long periods of time off work
- Belief that the individual should stay off work until treatment delivers a ‘total cure’.

Encourage:
- Normal activity, relationships, and work habits wherever possible (even if only for a small part of the day)
- Expectation that the individual will return to work and normal activity
- ‘Well’ behaviours – including alternative ways of performing tasks and focusing on transferable skills (but acknowledge any difficulties)
- Self-management and self responsibility
- Recognition and treatment of any emotional distress
- Recognition that pain can be controlled and managed
- Positive cooperation between the individual, the employer, the compensation system and health professionals
- Be prepared to ask for a second opinion, provided it does not result in a long and disabling delay

WARNING SIGNS

Red Flags (indicate that a potentially serious condition is present)
- Severe, unremitting night pain
- Associated night sweats
- Inappropriate weight loss
- Previous history of malignant disease
- Symptoms or signs suggestive of neurological compromise

Yellow Flags (signs associated with poor outcome)
- High initial Neck Disability Index scores, or very high initial visual analogue pain scale scores
- Cold hyperalgesia
- Older age
- Elevated levels of psychological distress
- Low education status
- Low socio-economic status
- Poor pre-accident health
- History of neck pain or headache prior to accident
- Unreasonable fear or anxiety regarding the nature or prognosis of the neck injury
PATIENT FORMS
- Patient information sheet
- Modified Oswestry Low Back Pain Disability Questionnaire
- Pain localization body chart
- Pain Visual Analogue Scale

HISTORY

Areas to focus on:
- Prior medical history, regular medication, allergies
- Pain severity, lumbar mobility, neurological symptoms
- Prior history of lower back injury or chronic pain conditions
- Presence or otherwise of negative mood, social withdrawal
- Presence or otherwise of excessive/ unrealistic anxiety in relation to injury
- Symptoms of low back pain or low back injury, prior to accident
- Effect of low back injury on patient's lifestyle including work capacity, social functioning and mood

PHYSICAL EXAMINATION

Areas to focus on:
- Lumbar range of motion
- Peripheral nervous system examination
- Central nervous system examination
- Palpation for tenderness around the lumbar sacral region
- Hip range of motion
- Presence of protective posturing
- Evidence of somatisation reaction
- Observation general habitus, level of fitness
- Measure body mass index

INVESTIGATIONS

Investigations | Indications
--- | ---
Radiological investigation in the first 4-6 weeks does not provide benefit unless there are Red Flags present (see back of this protocol for details)
Fracture is suspected and plain films are positive, suspicious or inadequate
Pain is persistent
Acute low back pain in association with neurological deficit

Red Flags* or structural damage present? YES - Refer to specialist

MANAGEMENT

- Provide clear information regarding the nature of the injury and the prognosis
- Encourage patient to move normally, even if this causes discomfort initially
- Provide a clear treatment plan (timeframes, medications, work restrictions, general activity restrictions and basic rehabilitation exercise regimes)

*See next page for list of Red and Yellow Flags
### Acute Lumbar Spine Injury

**Recommended interventions**

- Early activation
- Simple analgesics
- In some cases, specific exercises for the lumbar region, combined with treatment from a physiotherapist may be beneficial

**Review**

- Review weekly until patient returns to usual activities

**When to refer**

- If progress is delayed, reassess Red and Yellow Flags at 4 and 6 weeks
- Consider specialist referral at 4-8 weeks to prevent ongoing problems

### MAIN MESSAGES

**Discourage:**

- Long periods of time off work and/or the belief that the individual should stay off work until treatment delivers a "total cure"
- The assumption that difficulties with activities of daily living indicate all activity or any work must be avoided
- Expectations of simple "techno-fixes"

**Encourage:**

- Normal activity, relationships, and work habits wherever possible (even if only for a small part of the day)
- Expectation that the individual will return to work and normal activity
- ‘Well’ behaviours – including alternative ways of performing tasks and focusing on transferable skills (but acknowledge any difficulties)
- Self-management and self-responsibility
- Recognition and treatment of any emotional distress
- Recognition that pain can be controlled and managed
- Positive cooperation between the individual, the employer, the compensation system and health professionals
- Be prepared to ask for a second opinion, provided it does not result in a long and disabling delay

### WARNING SIGNS

**Red Flags (indicate that a potentially serious condition is present)**

- Features of Cauda Equina Syndrome (urinary retention, fecal incontinence, widespread neurological symptoms and signs in the lower limb, including gait abnormality, saddle area numbness and a lax anal sphincter)
- Significant trauma
- Weight loss
- History of cancer
- Fever
- Intravenous drug use
- Steroid use
- Patient over 50 years of age
- Severe, unremitting night-time pain
- Pain that gets worse when lying down

**Yellow Flags (potential psychosocial barriers to recovery)**

- Belief that pain and activity are harmful
- Low or negative moods, social withdrawal
- Problems at work, poor job satisfaction
- Previous history of back pain, time away from work, other compensation-related claims

- "Sickness behaviours" (like extended rest)
- Problems with claim and compensation
- Heavy work, unsociable hours
- Overprotective family or lack of support

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PATIENT FORMS

- Patient information sheet
- Disability of the Arm, Shoulder and Hand (DASH) Questionnaire
- Pain localisation body chart
- Pain Visual Analogue Scale

HISTORY

Areas to focus on:
- Prior medical history, regular medication, allergies
- Clicking, catching or Instability
- Prior history of shoulder injury or chronic pain conditions
- Presence or otherwise of negative mood, social withdrawal
- Presence or otherwise of excessive / unrealistic anxiety in relation to injury
- Symptoms of shoulder pain or shoulder injury prior to accident

PHYSICAL EXAMINATION

Areas to focus on:
- Cervical range of motion
- Peripheral nervous system examination
- Central nervous system examination
- Palpation for tenderness around the neck region
- Presence of protective posturing
- Evidence of normalization reaction
- Shoulder range of motion (bilateral for all shoulder examination tests)

- Assessment of rotator cuff strength
- Palpation of all major structures in the shoulder girdle
- Tests for glenohumeral stability
- Tests for subacromial impingement
- Tests for labral lesions
- Assessment of scapulothoracic function

INVESTIGATIONS

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<th>Imaging</th>
<th>Indications</th>
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<tbody>
<tr>
<td>X-Rays</td>
<td>Strong suspicion of fracture</td>
</tr>
<tr>
<td></td>
<td>Dislocation in those aged &gt; 40 years</td>
</tr>
<tr>
<td></td>
<td>Consideration of surgery as a management option (films best ordered by an orthopaedic specialist)</td>
</tr>
<tr>
<td>Diagnostic ultrasound</td>
<td>Suspected significant rotator cuff damage</td>
</tr>
</tbody>
</table>

MANAGEMENT

- Provide clear information regarding the nature of the injury and the prognosis
- Provide a clear treatment plan (timeframes, medications, work restrictions, general activity restrictions and basic rehabilitation exercise regimes)
- Provide necessary referrals to appropriate ancillary health care providers
- Encourage early return to normal work and social activities
- Note any indications for early referral (see Red Flags*)

*See page 3 for list of Red Flags

YES - Refer as necessary

NO
<table>
<thead>
<tr>
<th>Recommended interventions</th>
<th>Review</th>
<th>When to refer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rotator cuff disorders</strong></td>
<td>Review as necessary</td>
<td>Full-thickness tear: at 4-6 weeks if no improvement. Tendinitis/partial thickness tear: at 6 months if response is poor.</td>
</tr>
<tr>
<td>• Analgesics as required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Activity modification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Trial of rehabilitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Subacromial steroid injection if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frozen shoulder (adhesive capsulitis)</strong></td>
<td>4-6 weeks</td>
<td>Consider trial of rehabilitation if poor response, or refer to specialist.</td>
</tr>
<tr>
<td>• Intra-articular steroid injection by competent clinician</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Gentle home exercise program</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AC Joint sprain</strong></td>
<td>2-3 weeks</td>
<td>Consider trial of rehabilitation at 4-6 weeks if response is poor. Then refer to specialist if response is unsatisfactory.</td>
</tr>
<tr>
<td>• Sling if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Analgesics as required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ROM exercises as pain permits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Activity modification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Resume activities as tolerated</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anterior/recurrent dislocation</strong></td>
<td>2-3 days, then 10-14 days</td>
<td>Poor response</td>
</tr>
<tr>
<td>• Attempt reduction, if appropriate, using analgesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Refer urgently if unable to reduce</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Provide sling and analgesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Advise activity modification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Refer to specialist if ≥ 2 recurrent dislocations</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instability disorders</strong></td>
<td>Review as necessary</td>
<td>Poor response</td>
</tr>
<tr>
<td>• Refer for specialist evaluation and a definitive diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Treatment then involves activity modification and a comprehensive rehabilitation programme over 3-6 months</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACE= acromioclavicular, ROM= range of movement.
### MAIN MESSAGES

**Discourage:**
- Long periods off work and/or the belief that the individual should stay off work until treatment delivers a "total cure"
- The assumption that difficulties with activities of daily living indicate all activity or any work must be avoided
- Expectations of simple " techno-fixes"

**Encourage:**
- Normal activity, relationships, and work habits wherever possible (even if only for a small part of the day)
- Expectation that the individual will return to work and normal activity
- "Well" behaviours – including alternative ways of performing tasks and focusing on transferrable skills (but acknowledge any difficulties)
- Self-management and self-responsibility
- Recognition and treatment of any emotional distress
- Recognition that pain can be controlled and managed
- Positive cooperation between the individual, the employer, the compensation system and health professionals
- Be prepared to ask for a second opinion, provided it does not result in a long and disabling delay

### RED FLAGS

**Indications for immediate referral:**
- Unexplained deformity or swelling
- Significant weakness not due to pain
- Suspected malignancy
- Fever/chills/malaise
- Significant/unexplained sensory/motor deficit
- Pulmonary or vascular compromise

**Indications for urgent referral include:**
- Displaced or unstable fracture
- Failed attempt (x2) reduction of dislocated shoulder
- Massive tear of the rotator cuff (>5cm)
- Severe dislocation (GH, AC or SC joint)
- Undiagnosed severe shoulder pain

**Indications for early referral:**
- Two or more traumatic dislocations
- Recurrent posterior or other instabilities
- Full thickness tear of the rotator cuff and no improvement after 4–6 weeks
- Uncertain diagnosis
- Failure to recover within expected timeframe

GH = glenohumeral, AC = acromioclavicular, SC = sternoclavicular
PATIENT FORMS

- Patient Information sheet
- AOOS Hip and Knee Score
- Pain localisation body chart
- Pain Visual Analogue Scale

HISTORY

Areas to focus on:
- Prior medical history, regular medication, allergies
- Clicking, catching, ability to weight bear
- Prior history of hip injury or chronic pain conditions
- Presence or otherwise of negative mood, social withdrawal
- Presence or otherwise of excessive / unrealistic anxiety in relation to injury
- Symptoms of hip girdle injury, prior to accident
- How far the patient is able to walk
- Whether the patient is able to tie their own shoe laces on the affected side

PHYSICAL EXAMINATION

Areas to focus on:
- Hip range of motion
- Lumbar spine examination
- Presence of protective posturing
- Lower limb neurological system examination
- Palpation for tenderness, lumbar spine, sacroiliac joints, pelvis and greater trochanter

INVESTIGATIONS

The need for investigation will be based on clinical assessment.

Imaging

- Strong suspicion of lumbar, pelvic or femoral fracture
- Pain radiography is NOT indicated in the investigation of acute hip pain, if the initial examination demonstrates normal range of motion and negative hip joint provocation tests.
- CT scan
  - Fracture is suspected and plain films are positive, suspicious or inadequate
  - Pain is persistent
  - Patient is unable to weight bear
- MRI
  - Acute hip girdle pain in association with lumbar radiculopathy
  - Suspicion of avascular necrosis
- Regional bone scan
  - Persisting hip symptoms despite normal plain x-ray (particularly following a front-on-collision)

Red Flags* or significant structural damage/dislocation present?

YES - Refer as necessary

NO

MANAGEMENT

- Provide clear information regarding the nature of the injury and the prognosis
- Provide a clear treatment plan (timeframes, medications, work restrictions, general activity restrictions and basic rehabilitation exercise regime)
- Provide necessary referral to appropriate ancillary health care providers
- Be directive in scheduling regular reviews of progress
- Encourage early return to normal work and social activities
- Note any indications for early referral or more intrusive treatment (see Red and Yellow Flags*)

*See next page for list of Red and Yellow Flags
MAIN MESSAGES

Disourage:
- Long periods of time off work and/or the belief that the individual should stay off work until treatment delivers a "total cure"
- The assumption that difficulties with activities of daily living indicate all activity or any work must be avoided
- Expectations of simple "techno fixes"

Encourage:
- Normal activity, relationships, and work habits wherever possible (even if only for a small part of the day)
- Expectation that the individual will return to work and normal activity
- "Well" behaviours - including alternative ways of performing tasks and focusing on transferable skills (but acknowledge any difficulties)
- Self-management and self responsibility
- Recognition and treatment of any emotional distress
- Recognition that pain can be controlled and managed
- Positive cooperation between the individual, the employer, the compensation system and health professionals
- Be prepared to ask for a second opinion, provided it does not result in a long and disabling delay

WARNING SIGNS

Red Flags (indicate that a potentially serious condition is present)
- Severe, unremitting night pain
- Associated night sweats
- Inappropriate weight loss
- Previous history of malignant disease
- Symptoms or signs suggestive of neurological compromise

Yellow Flags (signs associated with poor outcome)
- More severe symptoms at initial assessment
- Initial injury reaction (sleep disturbance, nervousness)
- More initial subjective complaints and concern regarding long-term prognosis
- Pre-existing osteoarthritis on initial hip radiograph
- Prior history of psychological disturbance - these disturbances may be indicative of a proneness to emotional/affective problems and somatisation reactions, which are frequently based on affective disorders.
- Prior history of long-term problems in adjusting to symptoms of an injury or illness
- Current psychosocial problems in relation to family, occupation or finances
- Older age
- Not in full-time employment
- Having dependants
- Demonstrable injury to the hip joint itself
PATIENT FORMS
- Patient information sheet
- Pain localisation body chart
- Knee Outcome Survey
- Pain Visual Analogue Scale

HISTORY
Areas to focus on:
- Prior medical history, regular medication, allergies
- Clicking, locking, swelling, instability, ability to weight bear
- Prior history of knee injury or chronic pain conditions
- Presence or otherwise of negative mood, social withdrawal
- Presence or otherwise of excessive / unrealistic anxiety in relation to injury
- Symptoms of knee injury, prior to accident
- Effect of knee injury on patient's lifestyle including work capacity, social functioning and mood

PHYSICAL EXAMINATION
Areas to focus on:
- Gait observation
- Assess range of motion in relevant joints
- Ability to hop
- Evidence of somatisation reaction
- Measure body mass index
- Assess strength of relevant muscle groups
- Ability to walk on toes, walk on heels, balance on one leg, perform one-legged squat
- Look for deformity, swelling, effusion
- Palpation for focal tenderness
- Presence of protective posturing
- Observation general habits, level of fitness
- Assess joint stability including anterior drawer, Lachman's test, pivot shift test, posterior drawer, grinding test, meniscal provocation tests, patellofemoral provocation tests, patellar apprehension test, swap test

INVESTIGATIONS
Imaging Knee
Indications
A knee X-ray series is only necessary for acute knee injury in people with one or more of the following:
- Aged over 55 years
- Tenderness at the head of the fibula
- Isolated tenderness of the patella
- Inability to flex the knee to 90 degrees
- Inability to bear weight both immediately and in emergency department (four steps).

Red Flags* or structural damage present? YES - Refer as necessary
NO

MANAGEMENT
- Provide clear information regarding the nature of the injury and the prognosis
- Provide a clear treatment plan (timeframes, medications, work restrictions, general activity restrictions and basic rehabilitation exercise regimes)
- Provide necessary referrals to appropriate ancillary health care providers
- Encourage early return to normal work and social activities
- Note any Yellow Flags*

* See next page for list of Red and Yellow Flags
**Recommended interventions** | **Review** | **When to refer**
--- | --- | ---
Uncomplicated knee pain | Early activation | If patient has persisting pain that causes them to limp
Simple analgesics | | Suspected (or proven) fracture at any site, or evidence of intraarticular pathology within the knee (swelling, painful clicking and/or instability)
Structured rehabilitation program | | |

**MAIN MESSAGES**

**Discourage:**
- Long periods of time off work and/or the belief that the individual should stay off work until treatment delivers a "total cure"
- The assumption that difficulties with activities of daily living indicate all activity or any work must be avoided
- Expectations of simple "tech-no-fixes"

**Encourage:**
- Normal activity, relationships, and work habits wherever possible (even if only for a small part of the day)
- Expectation that the individual will return to work and normal activity
- "Well" behaviours – including alternative ways of performing tasks and focusing on transferable skills (but acknowledge any difficulties)
- Self-management and self-responsibility
- Recognition and treatment of any emotional distress
- Recognition that pain can be controlled and managed
- Positive cooperation between the individual, the employer, the compensation system and health professionals
- Be prepared to ask for a second opinion, provided it does not result in a long and disabling delay

**WARNING SIGNS**

**Red Flags**
Indications for URGENT referral to an orthopaedic surgeon:
- Neurovascular damage (high velocity injury, absent pulses, foot drop, multiple plane laxity)
- Extensor mechanism rupture (unable to actively straighten leg; palpable gap; change in height of patella)
- Infection (fever, severe pain, history drug abuse)
- Bleeding disorders (Haemophilia)
- Possibility of cancer (previous history of tumour, persistent severe pain, right pain)

**Indications for EARLY specialist referral:**
- Swelling within the knee
- Suspected injury to the anterior cruciate ligament, posterior cruciate ligament, or posterolateral complex
- Inability to weight bear
- Locked knee due to suspected meniscal entrapment
- Where the diagnosis is in doubt

**Yellow Flags** (potential psychosocial barriers to recovery)
- Belief that pain and activity are harmful
- Low or negative moods, social withdrawal
- Problems at work, poor job satisfaction
- Previous history of knee/ankle/foot pain, time away from work, other compensation-related claims
- "Sickness behaviours" (like extended rest)
- Problems with claim and compensation
- Heavy work, unsociable hours
- Overprotective family or lack of support
Foot/Ankle Injury
TREATMENT PROTOCOL

PATIENT FORMS

- Patient information sheet
- Pain localisation body chart
- AAOS Foot and Ankle Outcomes Questionnaire
- Pain Visual Analogue Scale

HISTORY

Areas to focus on:
- Prior medical history, regular medication, allergies
- Clicking, locking, swelling, instability, ability to weight bear
- Prior history of foot or ankle injury or chronic pain conditions
- Presence or otherwise of negative mood, social withdrawal
- Presence or otherwise of excessive/unrealistic anxiety in relation to injury
- Symptoms of foot or ankle injury, prior to accident
- Effect of foot or ankle injury on patient's lifestyle including work capacity, social functioning and mood

PHYSICAL EXAMINATION

Areas to focus on:
- Gait observation
- Assess range of motion in relevant joints
- Assess strength of relevant muscle groups
- Ability to hop
- Evidence of somatisation reaction
- Assess joint stability including anterior drawer, talar tilt, external rotation stress test, squeeze test (mid lower leg, midfoot, forefoot)
- Look for deformity, swelling, effusion
- Calcaneal squeeze test
- Palpation for local tenderness
- Presence of protective posturing
- Observation general habitus, level of fitness
- Measure body mass index
- Ability to walk on toes, walk on heels, balance on one leg, perform one-legged squat

INVESTIGATIONS

<table>
<thead>
<tr>
<th>Imaging</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle</td>
<td>An ankle X-ray series is only necessary if there is pain near the malleoli and any of these findings:</td>
</tr>
<tr>
<td></td>
<td>1. Inability to bear weight both immediately and in emergency department (four steps) OR</td>
</tr>
<tr>
<td></td>
<td>2. Bone tenderness at the posterior edge or tip of either malleolus</td>
</tr>
<tr>
<td>Foot</td>
<td>A foot X-ray series is only necessary if there is pain in the midfoot and any of these findings:</td>
</tr>
<tr>
<td></td>
<td>1. Inability to bear weight both immediately and in emergency department (four steps) OR</td>
</tr>
<tr>
<td></td>
<td>2. Bone tenderness at the navicular or base of the fifth metatarsal</td>
</tr>
</tbody>
</table>

Red Flags* or structural damage present?

YES - Refer as necessary

NO

MANAGEMENT

- Provide clear information regarding the nature of the injury and the prognosis
- Provide necessary referrals to appropriate ancillary health care providers
- Encourage early return to normal work and social activities
- Provide a clear treatment plan (timeframes, medications, work restrictions, general activity restrictions and basic rehabilitation exercise regimes)
- Note any Yellow Flags*

* See next page for list of Red and Yellow Flags
### Foot/Ankle Injury

**TREATMENT PROTOCOL**

<table>
<thead>
<tr>
<th>Recommended interventions</th>
<th>Review</th>
<th>When to refer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncomplicated ankle or foot pain</td>
<td>Early activation</td>
<td>Suspected (or proven) fracture at any site</td>
</tr>
<tr>
<td></td>
<td>Simple analgesics</td>
<td>Recurrent instability of the ankle</td>
</tr>
<tr>
<td></td>
<td>Structured rehabilitation program</td>
<td>Significant loss of range of motion in the ankle or</td>
</tr>
<tr>
<td></td>
<td>Use of a walking boot is often</td>
<td>Inability to weight bear on the toes, in the case of a</td>
</tr>
<tr>
<td></td>
<td>preferable to non weight bearing on</td>
<td>midfoot injury</td>
</tr>
<tr>
<td></td>
<td>crutches for minor ankle and foot injuries</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MAIN MESSAGES**

**Discourage:**
- Long periods of time off work and/or the belief that the individual should stay off work until treatment delivers a ‘total cure’
- The assumption that difficulties with activities of daily living indicate all activity or any work must be avoided
- Expectations of simple ‘techno-fries’

**Encourage:**
- Normal activity, relationships, and work habits wherever possible (even if only for a small part of the day)
- Expectation that the individual will return to work and normal activity
- ‘Well’ behaviours – including alternative ways of performing tasks and focusing on transferable skills (but acknowledge any difficulties)
- Self-management and self-responsibility
- Recognition and treatment of any emotional distress
- Recognition that pain can be controlled and managed
- Positive cooperation between the individual, the employer, the compensation system and health professionals
- Be prepared to ask for a second opinion, provided it does not result in a long and disabling delay

**WARNING SIGNS**

**Red Flags (indicate that a potentially serious condition is present):**
- Severe, unrelenting night pain
- Associated night sweats
- Inappropriate weight loss
- Previous history of malignant disease
- Symptoms or signs suggestive of neurological compromise

**Indications for EARLY specialist referral:**
- Inability to weight bear
- Persisting inability to weight bear on the toes, following an injury to the midfoot

**Yellow Flags (potential psychosocial barriers to recovery):**
- Belief that pain and activity are harmful
- Low or negative moods, social withdrawal
- Problems at work, poor job satisfaction
- Overprotective family or lack of support
- ‘Sickness behaviours’ (like extended rest)
- Problems with claim and compensation
- Heavy work, unsociable hours
- Previous history of knee/ankle/foot pain, time away from work, other compensation-related claims
Best practice management of soft tissue injuries sustained in motor vehicle accidents

Contents

1. Evidence-based medicine (EBM) and accident injuries

2. General principles of injury management

3. Recommendations for specific injury areas:
   - Whiplash associated disorders (WAD)
   - Shoulder pain
   - Lower back pain
   - Hip pain
   - Knee pain
   - Ankle or foot pain
Crash Course – Part 1

Car accident injury management in general practice

Learning Objectives

- Identify potential causes of neck pain
- Review best practice management of whiplash associated disorder (WAD) in general practice
- Learn to recognise patient factors that may affect recovery in WAD
- Learn how to optimise patient outcomes in WAD

Continuous Professional Development (CPD) points awarded for successful completion of course (available online or in physician-led group learning sessions)
DO YOU HAVE A MILD TO MODERATE INJURY?

- Bruising
- Whiplash
- Other similar injuries

You may be eligible to participate in the ACE (Accident Care Evaluation) Project. ACE is a study of ways to improve the health care of people who have been injured in motor vehicle crashes.

Ask our emergency room staff for an ACE brochure OR CALL 1300 557 479 between 9.00am and 7.00pm to speak to the ACE Research Coordinator.
Patient Information Brochure

Sample 8. Patient Information brochure – Control Group

MORE OF YOUR QUESTIONS ANSWERED

Who is running the ACE study?
Researcher from The Australian National University and The University of Sydney are conducting the study at hospitals and cereal hospitals. Other study partners include the AINAC, HMH, Safety Trust and Insurance Australia Group.

Can I leave the study if I want to?
Yes! You are free to withdraw your consent and stop participating in ACE without affecting your rehabilitation or your relationship with hospital staff.

What type of questions will be asked, and how much time will they take?
The questions will be about how you are feeling physically and emotionally, and about the impact of your injuries on your work. They will also ask whether you have them been able to go back to your usual activities.

Each set of questions will take about 15-20 minutes to complete.

What other information will the Research Coordinator collect?
One of the aims of ACE is to determine the financial costs of treating these severe injuries. In order to do this, we will ask for your permission to obtain data on services provided by you under Medicare, as well as the Medicare item numbers of those health services that you receive. This data will be used to estimate the cost of your medical care.

Note that the Medicare file will not record your Medicare Number in order to access data on the health services you have used. However, when you provide the information to us, they will not identify you by your name or Medicare number. This data will therefore be anonymous.

NEXT STEPS

The check at the emergency reception desk at the Emergency Department staff member who is attending to you may ask your name up to the ACE Research Coordinator who will explain the study further.

You will see the Research Coordinator at the hospital today. If they are unavailable, a further phone will be arranged for a meeting within the next 72 hours. You may examine your personal notes of the day to be contacted.

ACE participants:
- Have been injured as a passenger or driver of a motor vehicle involved in a crash in the ACT that happened less than 7 days ago.
- Have a minor to moderate injury.
- Attended the Emergency Department in Canberra or Calvary Hospital.
- Usually live in the ACT.
- Are between 15 and 70 years of age.

For more information about the ACE study contact the Research Coordinator on 1300 957 479 between 8:30am and 7:00pm.

WHAT IS THE ACCIDENT CARE EVALUATION (ACE) STUDY?

ACE is a medical research study being conducted by a group of Australian researchers in the Australian Capital Territory (ACT) region.

The aim of ACE is to find out more about the experiences of ACT residents who have recently been injured in a motor vehicle crash and explain some ways we help to improve their recovery.

This study is important because many people are injured in the way that they spend their time and they have to deal with the problems that arise.

What is the ACE study?

The ACE study is a Human Research Ethics Committee approved research project and participants are asked to complete a number of studies. The study will be conducted in the ACE study.


could I BE INVOLVED IN THE ACE STUDY?

Although not everyone who is asked to be part of the ACE study will participate, your participation in the study is important because it will help us to understand how to improve services for people who are in need in the future.

How ACE Works

- A Research Coordinator may contact you to provide you with the research information and ask your consent to be involved.
- Over the course of the study, the Research Coordinator will contact you to check how your recovery is progressing. The study will be done on a regular basis.
- The study will be done over a period of up to 12 months.
- You will be told if you are selected to take part in the study and you can ask any questions about the study.
- After 12 months your participation will end, and the ACE study may end and any relevant information will be collected.
- The study is funded by the Australian Capital Territory Health Services Commission.

For more information about the ACE study contact the Research Coordinator on 1300 957 479 between 8:30am and 7:00pm.

THE ACE STUDY

You go to the Emergency Department

Research Coordinator will contact you

A short time later (less than 3 days)

Research Coordinator will provide you with the research

6 months later

Research Coordinator will send you a second series of

12 months later

Research Coordinator will send you a third series of

YOUR PARTICIPATION ENDS

By participating in ACE you will be helping us plan and develop improved services for people who are injured in the future. Your privacy will be protected at all stages of the study.

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MORE OF YOUR QUESTIONS ANSWERED

What is running the ACE study?

Researchers from The Australian National University and the University of Sydney are conducting the study of patients seen at the Canberra Hospital and Calvary Hospital. Other study partners include the NHMRC ACT Road Safety Trust and Insurance Association Group.

Can I leave the study if I want to?

Yes! You are free to withdraw your consent and stop participating in ACE without affecting your rehabilitation or your relationship with hospital staff.

What type of questions will be asked and how much time will they take?

The questions will be about how you are feeling physically and emotionally, and about the types of health services you have used. They will also ask whether you have been able to go back to your usual activities.

Each set of questions will take about 15-25 minutes to complete.

What happens at the ACE Clinic?

At the ACE Clinic, a doctor who specializes in accident injuries will examine your injury and develop a treatment plan for you to take home. As part of your treatment plan you may also be referred to other specialists (such as a physiotherapist) for ongoing care.

What happens once I leave the clinic?

You can put your treatment plan into action with the help of your usual GP and any other healthcare providers to whom you have been referred. You will also be contacted by an ACE nurse who can help you with any questions you might have about your ongoing treatment.

WHAT IS THE ACCIDENT CARE EVALUATION (ACE) STUDY?

ACE is a medical research study being conducted by a group of Australian researchers in the Australian Capital Territory (ACT) region.

The aim of ACE is to find out more about the experiences of ACT residents who have recently been involved in a motor vehicle crash and explore some new ways to help improve their recovery.

This study is important because many people who are injured in the way you have experienced a long-term problem as a result. These health problems can prevent them from returning to normal activities at home and at work, and can impact on their quality of life.

If you have been involved in a motor vehicle crash and would like to participate in the study, please contact the Research Coordinator on 1300 507 479 between 9am and 5pm.

By participating in ACE you will be helping to plan and develop improved services for people who are injured in the future. Your privacy will be protected at all stages of the study.

THE ACE STUDY

You go to the Emergency Department

A short time later (less than 3 days)

You make an informed decision and return consent

6 months later

The Research Coordinator will contact you

You provide information consent to be interviewed and answer a series of questions

You attend the ACE Clinic and receive a treatment plan

12 months later

Research Coordinator will contact you to answer a second series of questions

YOU PARTICIPATE END

For more information about the ACE study, contact the Research Coordinator on 1300 507 479 between 9am and 5pm.

HOW ACE WORKS

- A Research Coordinator may contact you to provide more information and seek your formal consent to be involved.

- You will then be invited to attend the ACE Clinic. This clinic is staffed by healthcare professionals who will assess your injury and develop a treatment plan to guide your recovery. The clinic staff may also refer you to other specialists if necessary.

- In addition, an ACE nurse will be available to answer any questions you have about your ongoing treatment.

- Over the course of the study, the Research Coordinator will contact you to check how your recovery is progressing. You will be contacted once at the beginning of the project, then 6 months later.

- You won’t be identified in any of the reports that are written as part of the project, and the people conducting the project will be the only people who know your answer to the questionnaire.

- After 6 months, your participation will end, and the ACE project team will start analysing the data they have collected.

- The diagrams on page 4 depict the flow for the main steps of the project. The ACE Research Coordinator can tell you more about each step.

ANY INFORMATION ABOUT YOU THAT IS COLLECTED WILL REMAIN CONFIDENTIAL AND WILL NOT BE DISCLOSED TO ANY THIRD PARTIES.

The letters 'ACE' are a registered trade mark owned by the Australian National University. The University of Canberra and the ACT Road Safety Trust are members of the Innovation Network Company Limited, Canberra, ACT, 2000.
Sample 10. Healthcare professional brochure

OPINION POLLS ON THE ACE WEBSITE
Exchange insights and ideas with other healthcare professionals. A range of opinion polls will be presented and updated regularly.

ACE for patients
Patient education is a critical part of injury management. The ACE website provides the following patient resources with an emphasis on providing reassurance and painting a realistic picture of expectations for recovery:

- The fast road to recovery
  A downloadable booklet with information and advice about the physical and emotional changes patients may undergo as they recover with advice and exercises specific to a range of injury areas.
- Advice on diet, exercise, and work-related issues
- Patient stories
- Interactive bulletin board

All ACE materials have been developed in consultation with a group of General Practitioners and Specialists with expertise in motor vehicle accidents.

MORE ABOUT THE ACE STUDY
Enrolment criteria
Patients attending an emergency room at Canberra or Calvary Hospitals will be invited to participate in the ACE Study. If they fit the following criteria:
- They have been injured as passenger or driver of a motor vehicle in an accident that occurred in the ACT less than 3 years ago.
- They have a minor or moderate injury only
- They usually live in the ACT
- They are between 15 and 70 years of age.

Study design
The core aim of the ACE Study (in which patients received standard care if already been completed). The treatment arm (in which each patient attends a nominated referral service). The ACE Clinic) will commence in July 2009 and is due to end in December 2009. Approximately 1800 subjects are expected to participate in the study initially.

Evaluation of patient outcomes
Each patient is evaluated shortly after their enrolment, then at 6 months, and again at 12 months. Evaluation takes place using a set of validated health questionnaires assessing functional status, quality of life, and psychological distress. Permission will also be obtained from each patient in order to collect data on the services provided (Medicare, private health insurance, or compulsory third party insurance) in return to generate financial costs of patient care.

All financial and personal information will remain confidential and will not be disclosed to any third party.

For more information visit: www.aceaccident.com.au

INFORMATION AND RESOURCES FOR HEALTHCARE PROFESSIONALS
A key focus thought to influence healthcare outcomes of people who are injured in motor vehicle accidents in the timely access to quality healthcare providers who use evidence-based assessment, treatment, and rehabilitation practices.

www.aceaccident.com.au

ABOUT THE ACE STUDY
ACE is a research project coordinated by The Australian University, The University of Sydney, and the NHMRC ACT Road Safety Unit in association with the Australian Group. The focus of the study is to evaluate a rapid injury assessment and rehabilitation service for those injured in motor vehicle accidents in the ACT. (See the first page of this brochure for more details.)

It is hypothesized that the provision of this service will lead to improved health outcomes for injured people, and reduce the duration of illness and associated costs.

ACE resources for healthcare professionals
An educational programme has been developed by accident injury specialists to more widely disseminate key messages about best-practice injury care and management. Key resources include:

- The ACE website with detailed, injury-specific information for healthcare professionals and patients.
- Soft-tissue injury assessment and treatment protocols highlighted on the back of this fold-out brochure and available in full on the ACE website.

THE ACE WEBSITE
The ACE website is an interactive resource for healthcare professionals and for individuals who have sustained a minor to moderate soft-tissue injury in a motor vehicle accident. Registration is free and provides access to a wide range of education and training resources.

Resources to enhance your practice of evidence-based medicine:
- Literature reviews outlining the current evidence-based care for: (See the ACE website for more information about these topics.
  - Neck pain (associated disorders)
  - Shoulder
  - Lower back
  - Hip
  - Lower limb
- Detailed treatment algorithms for these injury areas

www.aceaccident.com.au

ONLINE TRAINING MATERIALS
The ACE website includes slidesheds for group education and training, or personal learning, focusing on the following topics:

- Managing patients with compensable injuries
- Why do patients with compensable injuries tend to have worse outcomes?
- A discussion of current knowledge in this area, and an overview of how you, as a healthcare professional, need to renew your thinking about compensation systems in the ACT.
- Best practice management of soft tissue injuries
- A discussion of key messages in the evidence-based management and treatment of soft tissue injuries sustained in motor vehicle accidents.

CME activities
Case studies for discussion and reflection, with online evaluation and CDP points. Topics include:
- Crash Course Part 1
  An interactive case study exploring best-practice principles in the assessment and management of whiplash, including pain management and psychosocial issues.
- Crash Course Part 2
  A scene of patient scenarios presenting neck, knee, and shoulder injuries. Providing insights into appropriate investigation, palpation and movement testing, pain management, and ways to improve health outcomes for people suffering from these injuries.

The ACT is grateful to DAWSON for sharing of this casestudy from their program. CRPS is an acronym for Complex Regional Pain Syndrome, which is a well-recognized condition in the ACE Study.

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Dear Colleagues,

Introducing the ACE Study – Resources for Healthcare Professionals treating accident injuries

There is high level evidence to suggest that people who are injured and have to navigate through the compensation system for that injury, have poorer health outcomes than people who suffer similar injuries but are not involved in the compensation process.

This finding has been the impetus for an Australian research project called the ‘Accident Care Evaluation (ACE) Study’, which is currently being carried out by The Australian National University and The University of Sydney, strongly supported by the NRMA ACT Road Safety Trust.

The ACE Study has two main components:

• A controlled trial in which individuals with minor motor vehicle accident injuries sustained in the ACT are offered access to a specialty musculoskeletal referral service called the ‘ACE Clinic’.
  • For the purposes of the trial we will be recruiting patients who have been involved in MVAs from the emergency departments of The Canberra Hospital and Calvary Hospital.
  • It is hypothesised that early and coordinated referral via this service will improve health outcomes for these patients.
  • Treatment will not be given at the ACE Clinic itself.

• An educational website with excellent evidence-based resources for patients and healthcare professionals.

We invite you to read the enclosed brochure ‘Information and Resources for Healthcare Professionals’ and visit the ACE website at www.accidentcare.com.au for more information.

If you have any further queries please don’t hesitate to contact us on 1300 557 479.

Kind regards

Associate Professor Paul N Smith FRACS
Chief Investigator, ACE Study
Appendix B Research Study Forms

Appendix B contains the consent forms and study questionnaire used in the ACE study. The consent forms and participant information sheets for Canberra Hospital and Calvary Hospital are shown first. These are followed by the consent forms for each of the institutions where data was sought for the economic component of the study (Medicare Australia, Medibank Private, Medical Benefits Fund, Health Care Fund, ACT Health and Insurance Australia Group. The participant questionnaire is shown following this.
ACE Consent Handbook

Were you involved in a motor vehicle crash?

Do you have a minor to moderate injury?

- Injuries
- Witness
- Other

You may be eligible to participate in the ACE study and help us discover how to improve services for people who are injured in the future.

Find out more and how you can get involved:

ACE
ACCIDENT CARE EVALUATION
WHAT IS THE ACCIDENT CARE EVALUATION [ACE] STUDY?

ACE is a medical research study being conducted by a group of Australian researchers in the Australian Capital Territory (ACT) region.

The aim of ACE is to find out more about the experiences of ACT residents who have recently been injured in a motor vehicle crash and explore some new ways to help improve their recovery.

The study is important because many people who are injured in this way experience long-term health problems as a result of their injuries. These health problems can prevent them from resuming normal activities at home and at work, and can impact on their quality of life.

HOW TO COMPLETE THIS HANDBOOK?

To complete the ACE Study criteria you will be required to fill out various forms. In some cases you will only need to fill out 1 form from each set. For example we require authorisation to request information from your health fund - each fund has a different form - you are only required to fill out the form relevant to your health fund.

1. Patient Information Sheet. This sheet details the ACE Study and the organisations who will be working with the supplied data. This sheet is for you to keep.

2. Study Consent form. This consent form gives the Research Coordinator your permission to conduct the ACE study and collect and collate your supplied data. Signing this consent form will provide a copy for you, a copy for the hospital, medical records and the original copy for the Research Team.

3. Medicare Participant Consent form. Participants are requested to complete this form. The original will go to Medicare, a copy for you and a copy for the Research Team.

4. Healthfund Consent forms. Participants are requested to only complete the form relating to their healthfund. The original will go to your healthfund, a copy for you and a copy for the Research Team.

5. ACT Health Consent form. Participants are requested to complete this form. The original will go to ACT Health, a copy for you and a copy for the Research Team.

6. Insurance Australia Group (IAG) Participant Consent form. Participants may be required to complete this form. The original will go to IAG, a copy for you and a copy for the Research Team.

IF YOU HAVE ANY QUESTIONS?

Feel free to ask your Research Coordinator on 1300 557 479 if you have any questions or concerns about any of the information you have been asked to provide.

THANKYOU...

Thankyou for your participation in the ACE Study. Your responses will help us to ensure that future staff and services will be available where they are most needed.
ACE - PARTICIPANT INFORMATION SHEET

You are invited to participate in this project which has been approved by the ACT Human Research and Ethics Committee and The Australian National University Human Research and Ethics Committee. The study is examining the experiences of people like yourself, who have recently sustained an injury as the result of a motor vehicle accident in the ACT. It is well known that many people who are involved in motor vehicle accidents experience long term health problems as a result of their injuries. The purpose of this study is to identify the problems that people experience due to their injuries and explore methods to improve their health outcome.

You have been selected as a possible participant in this project as you have suffered from an injury as the result of a motor vehicle accident. You will be invited to consent to form part of this project. We would like to ask you about how you are feeling about yourself and what helps you. We will do this by asking you to complete questionnaires seeking your thoughts and experiences with the process of getting back to your home and to your community. If you agree to participate in the project, you will be contacted by telephone and asked to complete questionnaires on three occasions over the twelve months after your injury. Each session will approximately take between 15-20 minutes to complete.

For some people participating in this project, you will be invited to attend a clinic which is designed to offer you assistance with recovery from injury. This will consist of access to a team of health professionals who will assess your injuries and develop treatment plans for those health professionals managing your injury. This service does not form part of the current health system, and will be available to people who are discharged from The Canberra or The Canberra Hospital Emergency Department after a certain date that has yet to be determined - it is likely to be early 2007. For people discharged from hospital before this time, the project will provide valuable information to evaluate how adequate current services assist people like yourself.

There will be no direct benefit to you as a result of participating in this project, although it should help to plan how we may improve services for people who are injured in the future.

Any information about you that is collected for this project will remain confidential and will not be disclosed so far as the law allows. You will not be identified in any of the reports of the project. Your answers to the questionnaires will only be known to the people conducting the project.

If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without it affecting your rehabilitation or relationship with the staff at Calvary or Canberra Hospital.

Should you have any problems or queries about the way in which the study was conducted, and do not feel comfortable contacting the research staff, you may contact either of the following organisations:

1. The ACT Department of Health Ethics Committee Secretary on Second Floor, North Building, London Circuit, Canberra City, ACT 2601 or phone 02 6206 0846.
2. The National Centre for Epidemiology and Population Health Local Ethics Subcommittee, The Australian National University ACT 2600 or phone 02 6125 5804

You will be given a copy of this form to keep. If you have any questions at a later time, you may contact:

The Research Coordinator
ACE Study
1300 557 479

Dr Paul Smith
Trauma and Orthopaedic Research Unit
Australian National University
02 6244 2122

Professor Jim Butter
National Centre for Epidemiology and Population Health
Australian National University
02 6125 5545

Dr Ian Cameron
Rehabilitation Studies Unit
University of Sydney
(02) 9380 9236

Dr Drew Richardson
Emergency Department
Canberra Hospital
02 6244 2418
CONSENT FORM TO PARTICIPATE IN THE ACCIDENT CARE EVALUATION [ACE] RESEARCH PROJECT

Consent Form to Participate in the Accident Care Evaluation Research Project

I, ________________________, (name of participant)

Address: ________________________
Suburb/town: ________________________ State: ________________________ Postcode: ________________________
Contact Phone Number: ________________________ Mobile Phone Number: ________________________

Have been asked to consent to my participation in a research project entitled:

ACCIDENT CARE EVALUATION

In relation to this project I have read the Patient Information Sheet and have been informed of the following points:

1. Approval has been given by the ACT Human Research and Ethics Committee (ACTHREC) and The Australian National University Human Research and Ethics Committee.
2. The aim of the project is to investigate how to improve the health outcomes for those people injured in motor vehicle accidents in the ACT.
3. The results obtained by the study may not be of direct benefit to my medical management but it is hoped will assist in the future management of those people injured in motor vehicle accidents in the ACT.
4. If I agree to take part in the study I will be contacted by the research coordinator and invited to participate in a telephone based questionnaire on three occasions over the twelve months following my accident. Additionally, I may be invited to attend a clinic staffed by a team of health professionals regarded as having expertise in the assessment of motor vehicle injuries where I will be assessed and treatment plans developed to assist my general practitioner and other healthcare professionals manage my injuries.
5. There are no possible adverse effects or risks related to the project as I will receive usual care for my injuries or if invited to attend the ACE Clinic will receive assessment and treatment based on National Medical Health and Research Guidelines.
6. Should I develop a problem which I suspect may have resulted from my involvement in this project, I am aware that I may contact the Chief Investigator Associate Professor Paul Smith (02 6244 2122).
7. Should I have any problems or queries about the way in which the study was conducted, and I do not feel comfortable contacting the research staff, I am aware that I may contact either of the following organisations:

   1. The ACT Department of Health Ethics Committee Secretary on Second Floor, North Building, London Circuit, Canberra City, ACT 2601 or phone 02 6205 0846.
   2. The National Centre for Epidemiology and Population Health Local Ethics Subcommittee, The Australian National University ACT 0200 or phone 02 6125 5604
8. I can refuse to take part in this project or withdraw from it at any time without affecting my medical care.
9. Participation in the project will not result in any extra medical and hospital costs to me.
10. I understand that the results of the research will be made accessible and that my involvement and my identity will not be revealed.
11. In giving my consent, I acknowledge that the relevant Chief Investigator and Co-Investigators directly involved in the study may examine my medical records only as they relate to their project.

After considering all of these points, I accept the invitation to participate in this project.
I also state that I have/have not participated in any other research project in the past three (3) months. If I have the details are as follows:

Signature of participant/volunteer: ________________________ Date: ________________________
Witness Name: ________________________ Signature of witness: ________________________
Investigator's or Investigator's Delegate Signature: ________________________
ACE - PARTICIPANT INFORMATION SHEET

You are invited to participate in this project which has been approved by the ACT Human Research and Ethics Committee and The Australian National University Human Research and Ethics Committee. The study is examining the experiences of people like yourself, who have recently sustained an injury as the result of a motor vehicle accident in the ACT. It is well known that many people who are involved in motor vehicle accidents experience long term health problems as a result of their injuries. The purpose of this study is to identify the problems that people experience due to their injuries and explore methods to improve their health outcome.

You have been selected as a possible participant in this project as you have suffered from an injury as the result of a motor vehicle accident. You will be invited to consent to form part of this project. We would like to ask you about how you are feeling about yourself and what helps you. We will do this by asking you to complete questionnaires seeking your thoughts and experiences with the process of getting back to your home and your community. If you agree to participate in the project, you will be contacted by telephone and asked to complete questionnaires on three occasions over the twelve months after your injury. Each session will approximately take between 15-20 minutes to complete.

For some people participating in this project, you will be invited to attend a clinic which is designed to offer you assistance with recovery from injury. This will consist of access to a team of health professionals who will assess your injuries and develop treatment plans for those health professionals managing your injury. This service does not form part of the current health system, and will be available to people who are discharged from The Calvary or The Canberra Hospital Emergency Department after a certain date that has yet to be determined - it is likely to be early 2007. For people discharged from hospital before this time, the project will provide valuable information to evaluate how adequate current services assist people like yourself.

There will be no direct benefit to you as a result of participating in this project, although it should help to plan how we may improve services for people who are injured in the future.

Any information about you that is collected for this project will remain confidential and will not be disclosed so far as the law allows. You will not be identified in any of the reports of the project. Your answers to the questionnaires will only be known to the people conducting the project.

If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without it affecting your rehabilitation or relationship with the staff at staff at Calvary or Canberra Hospital.

Should you have any problems or queries about the way in which the study was conducted, and do not feel comfortable contacting the research staff, you may contact any of the following organisations:

1. The ACT Department of Health Ethics Committee Secretary on Second Floor, North Building, London Circuit, Canberra City, ACT 2601 or phone 02 6206 0646.
2. The National Centre for Epidemiology and Population Health Local Ethics Subcommittee, The Australian National University ACT 0200 or phone 02 6125 5634.
3. Calvary Hospital Human Research Ethics Committee secretariat on 02 62015104.

You will be given a copy of this form to keep. If you have any questions at a later time, you may contact:

The Research Coordinator
ACE Study
1300 557 479

Dr Paul Smith
Trauma and Orthopaedic Research Unit
Australian National University
02 6244 2122

Dr Ian Cameron
Rehabilitation Studies Unit
University of Sydney
(02) 9809 9236

Professor Jim Butler
National Centre for Epidemiology
and Population Health
Australian National University
02 6125 5542

Dr Marielle Ruijgrok
Emergency Department
Calvary Hospital
02 6201 6111

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CONSENT FORM TO PARTICIPATE IN THE ACCIDENT CARE EVALUATION [ACE] RESEARCH PROJECT.

Consent Form to Participate in the Accident Care Evaluation Research Project

Name: __________________________
Address: __________________________
Suburb/town: __________________________
State: __________________________
Postcode: __________________________
Contact Phone Number: __________________________
Mobile Phone Number: __________________________

Have been asked to consent to my participation in a research project entitled:

ACCIDENT CARE EVALUATION

In relation to this project I have read the Patient Information Sheet and have been informed of the following points:

1. Approval has been given by the ACT Human Research and Ethics Committee (ACTHREC) and The Australian National University Human Research and Ethics Committee.
2. The aim of the project is to investigate how to improve the health outcomes for those people injured in motor vehicle accidents in the ACT.
3. The results obtained by the study may not be of direct benefit to my medical management but it is hoped will assist in the future management of those people injured in motor vehicle accidents in the ACT.
4. If I agree to take part in the study I will be contacted by the research coordinator and invited to participate in a telephone based questionnaire on three occasions over the twelve months following my accident. Additionally I may be invited to attend a clinic staffed by a team of health professionals regarded as having expertise in the assessment of motor vehicle injuries where I will be assessed and treatment plans developed to assist my general practitioner and other health professionals manage my injuries.
5. There are no possible adverse effects or risks related to the project as I will receive usual care for my injuries or if invited to attend the ACE Clinic will receive assessment and treatment based on National Medical Health and Research Guidelines.
6. Should I develop a problem which I suspect may have resulted from my involvement in this project, I am aware that I may contact the Chief Investigator Associate Professor Paul Smith (02 6244 2122).
7. Should I have any problems or queries about the way in which the study was conducted, and I do not feel comfortable contacting the research staff, I am aware that I may contact any of the following organisations:
   1. The ACT Department of Health Ethics Committee Secretary on Second Floor, North Building, London Circuit, Canberra City, ACT 2601 or phone 02 6205 0846.
   2. The National Centre for Epidemiology and Population Health Local Ethics Subcommittee, The Australian National University ACT 0200 or phone 02 6125 5604.
   3. Calvary Hospital Human Research Ethics Committee secretariat on 02 6201 5104.
8. I can refuse to take part in this project or withdraw from it at any time without affecting my medical care.
9. Participation in the project will not result in any extra medical and hospital costs to me.
10. I understand that the results of the research will be made accessible and that my involvement and my identity will not be revealed.
11. In giving my consent, I acknowledge that the relevant Chief Investigator and Co-Investigators directly involved in the study may examine my medical records only as they relate to their project.

After considering all of these points, I accept the invitation to participate in this project.
I also state that I have/have not participated in any other research project in the past three (3) months. If I have the details are as follows:

Signature of participant/volunteer: __________________________
Date: __________________________
Witness Name: __________________________
Signature of witness: __________________________
Investigator's or Investigator's Delegate Signature: __________________________
ACE STUDY - PARTICIPANT CONSENT FORM FOR MEDICARE AUSTRALIA

Consent for Participation in, and release of Medicare Benefits Scheme (MBS) and Pharmaceutical Benefits Scheme (PBS) information for the purposes of, the Accident Care Evaluation [ACE] Study.

Please complete this form in BLOCK LETTERS. All details in the first section MUST be completed.

Full Name of Participant:

Address:

Contact Phone Number: Gender: Male ☐ Female ☐

Medicare Card Number: Date of Birth:

Date of accident: Consent valid from: to:

Specified Medicare information is required for all your Medicare claims (including Pharmaceutical Benefits Scheme data) for a period of 12 months from the date of the motor vehicle accident which is the basis of your enrolment in this study. For MBS data, these details will be: date of service; Medicare item number; fee charged; Medicare rebate paid; in-hospital service flag; increase in benefit paid due to safety net provisions; and registered major specialty of provider. For PBS data, these details will be: date of script; original/repeat script flag; date of supply; item code; brand of item; strength and quantity; payment category; and cost.

Participant's Signature: Date:

Participant is unable to sign:

Signature of Witness: Date:

Full Name of Witness:

Reason Participant is unable to sign:

Relationship to Participant:

Please attach supporting documentation/evidence of reason Participant is unable to sign.

This form will be collected by the ACE Research Coordinator, or other member of the research team, and forwarded to Medicare Australia for processing.

By signing this form, you are acknowledging that you have read, and agree to all details contained overleaf.
ACE STUDY - PARTICIPANT CONSENT FORM FOR MEDICARE AUSTRALIA

Important information: To be read by the Participant.

1. I agree to be a Participant in the Accident Care Evaluation (ACE) Study.

2. I have been provided with information about this Project including how this Project will access, store, use and disclose information about me. I have been given an opportunity to ask questions and have been fully informed about this Project. I understand that my participation is entirely voluntary and that my participation will not have any effect on my personal dealings with Medicare Australia.

3. My consent for the release of my MBS and PBS data will be from the Date of Accident specified on this form for a period of 12 months. I can elect to withdraw my consent for the release of these data at any time. I can also elect to withdraw from this Project (or I may become ineligible to participate in this Project) at any time (refer point 7 for more information).

4. I understand that my details on this consent form will be provided to Medicare Australia.

5. I agree to Medicare Australia releasing the specified MBS and PBS information about me to the Australian National University, and understand that this specified information will be collected, stored and analysed only for the purposes of this Project.

6. I understand that the specified MBS and PBS information about me will not be published in a manner that could identify me as an individual, during or after the conclusion of this Project.

7. I understand that I can, at any time, withdraw my consent to participate in this Project (and to the further release of my Medicare claims information). Should I wish to withdraw my consent, I can do so by:
   - telephoning ACE Research Coordinator on 1300 557 479; or
   - writing to:
     Accident Care Evaluation (ACE)
     PO Box 117
     Deakin West ACT 2600

8. I also understand I may become ineligible should I no longer meet the criteria for the study.

9. In the event that I withdraw my consent, I understand that the effective date of this notification will be the date on which my withdrawal notice is received either by Medicare Australia, or this Project, and that information about me collected prior to this date will continue to be used and form part of this Project.

10. I understand that specified information about me collected for the purposes of this Project could be stored for a period of seven years after the conclusion of this Project, or until the completion of the evaluation of this Project, whichever date occurs last. At the end of this period, this information will be destroyed.

Alternative forms of signature
Where the Participant or person who is consenting on behalf of the Participant is unable to sign due to illiteracy or physical impairment, the signature on the consent form may be in the form of the written name of the person who can give consent on behalf of the Participant, or a mark made by that person, if they are unable to sign. The mark on the consent form must be noted as his or her signature by a witness who is known to that person and be accompanied by information as to why they are unable to sign on their own behalf.
1. ACE STUDY - PARTICIPANT CONSENT FORM FOR HCF

Consent for Participation in, and release of HCF information for the purposes of the Accident Care Evaluation [ACE] Study.

Please complete this form in BLOCK LETTERS. All details in the first section MUST be completed.

Full Name of Participant: ____________________________

Address: ________________________________________

Contact Phone Number: ____________________________ Gender: Male ☐ Female ☐

Date of Birth: __________________ Date of accident: __________________

Consent valid from: ____________________________ to: ____________________________

Policy Number: ____________________________

Specified data required for this study is information on each health service for which you have received a benefit from your private health insurer for a period of 12 months from the date of the motor vehicle accident which is the basis of your enrolment in this study. These details will include the date and type of service, any codes relating to your principal and other diagnoses and procedures performed, and the fees charged and benefits paid for the service.

Participant’s Signature: ____________________________ Date: / /

Participant is unable to sign:

Signature of Witness: ____________________________ Date: / /

Full Name of Witness: ____________________________

Reason Participant is unable to sign:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Relationship to Participant:

Please attach supporting documentation/evidence of reason Participant is unable to sign.

This form will be collected by the ACE Research Coordinator, or other member of the research team, and forwarded to HCF.

By signing this form, you are acknowledging that you have read, and agree to all details contained overleaf.
1. ACE STUDY - PARTICIPANT CONSENT FORM FOR HCE

Important information: To be read by the Participant or their legal guardian.
Please refer to below regarding signature requirements.

1. I agree to be a Participant in the Accident Care Evaluation (ACE) Study
2. I have been provided with information about this Project including how this Project will access, store, use and disclose information about me. I have been given an opportunity to ask questions and have been fully informed about this Project. I understand that my participation is entirely voluntary and that my participation will not have any affect on my personal dealings with HCF.
3. My participation in this Project will be from the commencement date to the end date specified on this form, or to the end of this Project. I can elect to withdraw from this Project (or I may become ineligible to participate in this Project), at any time (refer point 8 for more information).
4. I understand that this Project may continue, unless I am otherwise notified. In the event that this Project exceeds the 3 year maximum period of consent, this Project will be required to obtain a new consent form signed by me.
5. I understand that my details on this consent form will be provided to HCF.
6. I agree to HCF releasing the specified information about my health services to The Australian National University, and understand that the specified information will be collected, stored and analysed only for the purposes of this Project.
7. I understand that the specified information about me will not be published in a manner that could identify me as an individual, during or after the conclusion of this Project.
8. I understand that I can, at any time, withdraw my consent to participate in this Project (and to the further release of information about my episodes of hospitalisation). Should I wish to withdraw my consent, I can do so by:
   • telephoning the ACE Project Officer on 1300 557 479;
   • writing to the ACE Project Officer, Accident Care Evaluation Study, PO Box 117, Dandenong West ACT 2601.
   I also understand I may become ineligible should I no longer meet the criteria for the study.
9. In the event that I withdraw my consent, I understand that the effective date of this notification will be the date on which my withdrawal notice is received either by HCF, or this Project, and that information about me collected prior to this date will continue to be used as part of this Project.
10. I understand that specified information about me collected for the purposes of this Project could be stored for a period of seven years after the conclusion of this Project, or until the completion of the evaluation of this Project, whichever date occurs first. At the end of this period, my information will be destroyed.
11. I understand that information will be handled in accordance with the Australian National University Privacy Policy and National Health and Medical Research Council Guidelines. I can obtain a copy of this information from the Research Coordinator at http://www.anu.edu.au/legaldocuments.
12. I understand that the clinical trial and the economic evaluation are being conducted as separate activities and by different researchers. Hence no data collected for the purposes of the economic evaluation will be passed on to those who are actually conducting the clinical trial (e.g. the professional staff working in the multi-disciplinary assessment clinic).

Authorised Person who can sign for the Participant

If the subject is incapacitated, signatures are required on the consent form FROM BOTH:
   (a) the person holding a power of attorney that extends to the right to make decisions about the persons’ health and welfare; and
   (b) the person holding a power of attorney to make financial decisions on behalf of the subject.

The Project requires confirmation of these authorities, so a photocopy of the authorising documents must be attached to this form.

If there is no power of attorney as above (for instance, a spouse caring for a mentally or physically incapacitated partner), you can consent to participate in the Project on that person’s behalf, provided that the following two statements are attached to this form:

   • A letter from the prospective Participant’s usual medical practitioner advising that the individual concerned does not have the mental or physical capacity to consent on his or her own behalf and that participation in the Project is not contrary to the individual’s best interests; and
   • A statement from you (eg. the carer) attesting to the fact that you ordinarily make health decisions on behalf of the incapacitated individual.

Signature of the person holding a power of attorney that extends to the right to make decisions about the persons’ health and welfare: AND/ OR

Signature of the person holding a power of attorney to make financial decisions on behalf of the subject

If there is no power of attorney as above (for instance, a spouse caring for a mentally or physically incapacitated partner), you can consent to participate in the Project on that person’s behalf, provided that the following two statements are attached to this form:

   • A letter from the prospective Participant’s usual medical practitioner advising that the individual concerned does not have the mental or physical capacity to consent on his or her own behalf and that participation in the Project is not contrary to the individual’s best interests; and
   • A statement from you (eg. the carer) attesting to the fact that you ordinarily make health decisions on behalf of the incapacitated individual.

Alternative forms of signature

Where the Participant or person who is consenting on behalf of the Participant is unable to sign due to illiteracy or physical impediment, the signatures on the consent form may be in the form of the written name of the person who can give consent on behalf of the Participant, or a mark made by that person, if they are unable to sign. This mark on the consent form must be noted as his or her signature by a witness who is known to that person and be accompanied by information as to why they are unable to sign on their own behalf.
2. ACE STUDY - PARTICIPANT CONSENT FORM FOR MEDICAL BENEFITS FUND

Consent for Participation in, and release of health service for the purposes of the Accident Care Evaluation (ACE) Study.

Please complete this form in BLOCK LETTERS. All details in the first section MUST be completed.

Full Name of Participant: ____________________________ Gender: Male [ ] Female [ ]

Address: ____________________________________________ Date of Accident: __________

Contact Phone Number: ____________________________ Date of Birth: __________

Date of Accident: __________ Policy Number: ____________________________

Consent valid from: __________ to: __________

Specified data required for this study is information on each health service for which you have received a benefit from your private health insurer for a period of 12 months from the date of the motor vehicle accident which is the basis of your enrolment in this study. These details will include the date and type of service, any codes relating to your principal and other diagnoses and procedures performed, and the fees charged and benefits paid for the service.

Participant's Signature: ____________________________ Date: __________

Participant is unable to sign:

Signature of Witness: ____________________________ Date: __________

Full Name of Witness: ____________________________

Reason Participant is unable to sign:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Relationship to Participant:

Please attach supporting documentation/evidence of reason Participant is unable to sign.

This form will be collected by the ACE Research Coordinator, or other member of the research team, and forwarded to Medical Benefits Fund.

By signing this form, you are acknowledging that you have read, and agree to all details contained overleaf.
2. ACE STUDY - PARTICIPANT CONSENT FORM FOR MEDICAL BENEFITS FUND

Important information: To be read by the Participant or their legal guardian.
Please refer to below regarding signature requirements.

1. I agree to be a Participant in the Accident Care Evaluation (ACE) Study.
2. I have been provided with information about this Project including how this Project will access, store, use and disclose information about me. I have been given an opportunity to ask questions and have been fully informed about this Project. I understand that my participation is entirely voluntary and that my participation will not have any effect on my personal dealings with Medical Benefits Fund.
3. My participation in this Project will be from the commencement date to the end date specified on this form, or to the end of this Project. I can elect to withdraw from this Project (or I may become ineligible to participate in this Project), at any time (refer point 6 for more information).
4. I understand that this Project is not yet ongoing, unless I am otherwise notified. In the event that this Project exceeds the last year maximum period of consent, this Project will be required to obtain a new consent form signed by me.
5. I understand that my details on this consent form will be provided to Medical Benefits Fund.
6. I agree to Medical Benefits Fund releasing the specified information about my health services to The Australian National University and understand that this specified information will be collected, stored and analysed only for the purposes of this Project.
7. I understand that the specified information about me will not be published in a manner that could identify me as an individual, during or after the conclusion of this Project.
8. I understand that I can, at any time, withdraw my consent to participate in this Project (and to the further release of information about my activities of hospitalisation). Should I wish to withdraw my consent, I can do so by:
   - telephoning the ACE Project Officer on 1300 557 479; or
   - writing to the ACE Project Officer, Accident Care Evaluation Study, PO Box 117, Deakin West ACT 2601
   I also understand I may become ineligible should I no longer meet the criteria for the study.
9. In the event that I withdraw my consent, I understand that the effective date of this notification will be the date on which my withdrawal notice is received either by Medical Benefits Fund, or this Project, and that information about me collected prior to this date will continue to be used and form part of this Project.
10. I understand that specified information about me collected for the purposes of this Project could be stored for a period of seven years after the conclusion of this Project, or until the completion of the evaluation of this Project, whichever date occurs last. At the end of this period, this information will be destroyed.

Authorized Person who can sign for the Participant
If you are a guardian or you have a power of attorney that extends to the right to make decisions about the person’s health care, you can sign the consent form on behalf of that person. The Project requires confirmation of this authority, so a photocopy of authorising document must be attached to this form.
If there is no power of attorney as above (for instance, a spouse caring for a mentally or physically incapacitated partner), you can consent to participate in the Project on that person’s behalf, provided that the following two statements are attached to this form:
   - A letter from the prospective Participant’s usual medical practitioner advising that the individual concerned does not have the mental or physical capacity to consent on his or her own behalf and that participation in the Project is not contrary to the individual’s best interests; and
   - A statement from you (eg. the care) attesting to the fact that you uniformly make health decisions on behalf of the incapacitated individual.

Alternative forms of signature
Where the Participant or person who is consenting on behalf of the Participant is unable to sign due to illiteracy or physical impairment, the signature on the consent form may be in the form of the written name of the person who can give consent on behalf of the Participant, or a mark made by that person, if they are unable to sign. The mark on the consent form must be notated as his or her signature by a witness who is known to that person and be accompanied by information as to why they are unable to sign on their own behalf.
3. ACE STUDY - PARTICIPANT CONSENT FORM FOR MEDIBANK PRIVATE LIMITED

Consent for Participation in, and release of health service for the purposes of the Accident Care Evaluation (ACE) Study

Please complete this form in BLOCK LETTERS. All details in the first section MUST be completed.

Full Name of Participant: ________________________________

Address: ______________________________________________________

Contact Phone Number: ____________________________ Gender: Male ☐ Female ☐

Date of Birth: ____________________________ Policy Number: ____________ Date of accident: ____________

Consent valid from: ____________________________ to: ____________________________

Specified data required for this study is information on each health service for which you have received a benefit from your private health insurer for a period of 12 months from the date of the motor vehicle accident which is the basis of your enrolment in this study. These details will include the date and type of service, any codes relating to your principal and other diagnoses and procedures performed, and the fees charged and benefits paid for the service.

Participant’s Signature: ____________________________ Date: __/__/____

Participant is unable to sign: ____________________________

Signature of Witness: ____________________________ Date: __/__/____

Full Name of Witness: ____________________________

Reason Participant is unable to sign: ________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

Relationship to Participant: ____________________________

Please attach supporting documentation/evidence of reason Participant is unable to sign.

This form will be collected by the ACE Research Coordinator, or other member of the research team, and forwarded to Medibank Private Limited.

By signing this form, you are acknowledging that you have read, and agree to all details contained overhead.
3. ACE STUDY - PARTICIPANT CONSENT FORM FOR MEDIBANK PRIVATE LIMITED

1. I agree to be a Participant in the Accident Care Evaluation (ACE) Study.

2. I have been provided with information about this Project including how this Project will access, store, use and disclose information about me. I have been given an opportunity to ask questions and have been fully informed about this Project. I understand that my participation is entirely voluntary and that my participation will not have any effect on any personal dealings with Medibank Private Limited.

3. My participation in this Project will be from the commencement date to the end date specified on this form, or to the end of this Project. I can elect to withdraw from this Project (or may become ineligible to participate in this Project), at any time (refer page 6 for more information).

4. I understand that this Project may be ongoing, unless I am otherwise notified. In the event that this Project exceeds the five year maximum period of consent, this Project will be required to obtain a new consent form signed by me.

5. I understand that my details on this consent form will be provided to Medibank Private Limited.

6. I agree to Medibank Private Limited releasing the specified information about my health services to The Australian National University and understand that this specified information will be collected, stored and analysed only for the purposes of this Project.

7. I understand that the specified information about me will not be published in a manner that could identify me as an individual, during or after the conclusion of this Project.

8. I understand that I can, at any time, withdraw my consent to participate in this Project (and to the further release of information about my episodes of hospitalisation). Should I wish to withdraw my consent, I can do so by:
   a) Telephoning the ACE Project Officer on 1300 557 479; or
   b) Writing to the ACE Project Officer, Accident Care Evaluation Study, PO Box 117, Dee Why West ACT 2601.

9. I also understand that I may become ineligible should I no longer meet the criteria for the study.

10. In the event that I withdraw my consent, I understand that the effective date of this notification will be the date on which my withdrawal notice is received either by Medibank Private Limited, or the ACE Project Officer, and that information about me collected prior to this date will continue to be used and form part of this Project.

11. I understand that specified information about me collected for the purposes of this Project could be stored for a period of seven years after the conclusion of this Project, or until the completion of the evaluation of this Project, whichever date occurs first. At the end of this period, this information will be destroyed.

12. I understand that information will be handled in accordance with the Australian National University Privacy Policy and National Health and Medical Research Council Guidelines. I can obtain a copy of this information from the Research Coordinator by calling 1300 557 479.

Authorised Person who can sign for the Participant

If the subject is incapacitated, signatures are required on the consent form from BOTH:

(a) the person holding a power of attorney that extends to the right to make decisions about the person’s health and welfare; and

(b) the person holding a power of attorney to make financial decisions on behalf of the subject.

The Project requires confirmation of these authorities, so a photocopy of the authorising documents must be attached to this form.

If there is no power of attorney as above (for instance, a spouse caring for a mentally or physically incapacitated partner), you can consent to participate in the Project on that person’s behalf, provided that the following two statements are attached to this form:

- A letter from the prospective Participant’s usual medical practitioner advising that the individual concerned does not have the mental or physical capacity to consent on his or her own behalf and that participation in the Project is not contrary to the individual’s best interests; and

- A statement from you (eg. the carer) attesting to the fact that you ordinarily make health decisions on behalf of the incapacitated individual.

Signature of the person holding a power of attorney that extends to the right to make decisions about the person’s health and welfare: AND / OR

Signature of the person holding a power of attorney to make financial decisions on behalf of the subject

Alternative forms of signature

Where the Participant or person who is consenting on behalf of the Participant is unable to sign due to illiteracy or physical impediment, the signature on the consent form may be in the form of the written name of the person who can give consent on behalf of the Participant, or a mark made by that person, if they are unable to sign. The mark on the consent form must be noted as his or her signature by a witness who is known to that person and be accompanied by information as to why they are unable to sign on their own behalf.
PARTICIPANT CONSENT FORM FOR ACT HEALTH

Consent for Participation in, and release of Hospital Morbidity Data for the purposes of the Accident Care Evaluation (ACE) Study.

Please complete this form in BLOCK LETTERS. All details in the first section MUST be completed.

Full Name of Participant:

Address:

Contact Phone Number: __________________________ Gender: Male ☐ Female ☐

Date of Birth: ___________ Consent valid from: ___________ to: ___________

Specified data required for this study is information on each episode of hospitalisation you have had in the ACT for a period of 12 months from the date of the motor vehicle accident which is the basis of your enrolment in this study. These details will include your admission and discharge date, and all codes relating to your principal and other diagnoses and procedures performed.

Participant's Signature: ______________________ Date: ___________

Participant is unable to sign:

Signature of Witness: ______________________ Date: ___________

Full Name of Witness: ______________________

Reason Participant is unable to sign:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Relationship to Participant:

Please attach supporting documentation/evidence of reason Participant is unable to sign.

This form will be collected by the Research Coordinator, or other member of the research team, and forwarded to ACT Health.

By signing this form, you are acknowledging that you have read, and agree to all details contained overleaf.
PARTICIPANT CONSENT FORM FOR ACT HEALTH

Important information: To be read by the Participant or their legal guardian. Please refer to below regarding signature requirements.

1. I agree to be a Participant in the Accident Care Evaluation (ACE) Study

2. I have been provided with information about this Project including how this Project will access, store, use and disclose information about me. I have been given an opportunity to ask questions and have been fully informed about this Project. I understand that my participation is entirely voluntary and that my participation will not have any affect on my personal dealings with ACT Health.

3. My participation in this Project will be from the commencement date to the end date specified on this form, or to the end of this Project. I can elect to withdraw from this Project (or I may become ineligible to participate in this Project), at any time (refer point 8 for more information).

4. I understand that this Project is/will be ongoing, unless I am otherwise notified. In the event that this Project exceeds the five year maximum period of consent, this Project will be required to obtain a new consent form signed by me.

5. I understand that my details on this consent form will be provided to ACT Health.

6. I agree to ACT Health releasing the specified Medicare claims information about me to the Australian National University, and understand that this specified information will be collected, stored and analysed only for the purposes of this Project.

7. I understand that the specified information about me will not be published in a manner that could identify me as an individual, during or after the conclusion of this Project.

8. I understand that I can, at any time, withdraw my consent to participate in this Project (and to the further release of information about my episodes of hospitalisation). Should I wish to withdraw my consent, I can do so by:
   + telephoning the ACE Project Officer on 1300 557 479; or
   + writing to the ACE Project Officer, Accident Care Evaluation Study, PO Box 117, Deakin West ACT 2601.
   I also understand I may become ineligible should I no longer meet the criteria for the study.

9. In the event that I withdraw my consent, I understand that the effective date of this notification will be the date on which my withdrawal notice is received either by ACT Health, or this Project, and that information about me collected prior to this date will continue to be used and form part of this Project.

10. I understand that specified information about me collected for the purposes of this Project could be stored for a period of seven years after the conclusion of this Project, or until the completion of the evaluation of this Project, whichever date occurs last. At the end of this period, this information will be destroyed.

Authorised Person who can sign for the Participant

If you are a guardian or you have a power of attorney that extends to the right to make decisions about the person's health care, you can sign the consent form on behalf of that person. The project requires confirmation of this authority, so a photocopy of authorising document must be attached to this form.

If there is no power of attorney as above (for instance, a spouse caring for a mentally or physically incapacitated partner), you can consent to participate in the Project on that person's behalf, provided that the following two statements are attached to this form:

+ A letter from the prospective Participant's usual medical practitioner advising that the individual concerned does not have the mental or physical capacity to consent on his or her own behalf and that participation in the Project is not contrary to the individual's best interests; and,
+ A statement from you (eg, the carer) attesting to the fact that you ordinarily make health decisions on behalf of the incapacitated individual.

Alternative forms of signature

Where the Participant or person who is consenting on behalf of the Participant is unable to sign due to illiteracy or physical impairment, the signature on the consent form may be in the form of the written name of the person who can give consent on behalf of the Participant, or a mark made by that person. If they are unable to sign, The mark on the consent form must be noted as his or her signature by a witness who is known to that person and be accompanied by information as to why they are unable to sign on their own behalf.
PARTICIPANT CONSENT FORM FOR INSURANCE AUSTRALIA GROUP

Consent for participation in, and release of health service for the purposes of the Accident Care Evaluation [ACE] Study

Please complete this form in BLOCK LETTERS. All details in the first section MUST be completed.

Full Name of Participant: ___________________________ ___________________________

Address: ____________________________________________________________

Contact Phone Number: ___________________________ Gender: Male ☐ Female ☐

Date of Birth: ___________ Consent valid from: ___________

Specified data required for this study is information on each health service for which you receive a benefit under the compulsory third party insurance scheme in the ACT operated by Insurance Australia Limited on behalf of Insurance Australia Group (IAG) for a period of 12 months from the date of the motor vehicle accident which is the basis of your enrolment in this study. These details will include the date and type of service, any codes relating to your principal and other diagnoses and procedures performed, and the fees charged and benefits paid for the service. Your consent is also sought for the release of data on other aspects of your claim, such as the amount of economic loss and general damages sought and awarded.

Participant's Signature: ___________________________ Date: ___________

Participant is unable to sign: ___________________________ ___________________________

Signature of Witness: ___________________________ Date: ___________

Full Name of Witness: ___________________________ ___________________________

Reason Participant is unable to sign: __________________________________________

Relationship to Participant: ___________________________ ___________________________

Please attach supporting documentation/evidence of reason Participant is unable to sign.

This form will be collected by the Research Coordinator, or other member of the research team, and forwarded to Insurance Australia Limited Group.

By signing this form, you are acknowledging that you have read, and agree to all details contained herein.
PARTICIPANT CONSENT FORM FOR INSURANCE AUSTRALIA GROUP

Important Information: To be read by the Participant or their legal guardian.
Please refer to below regarding signature requirements.

1. I agree to be a Participant in the Accident Care Evaluation (ACE) Study

2. I have been provided with information about this Project including how this Project will access, store, use and disclose information about me. I have been given an opportunity to ask questions and have been fully informed about this Project. I understand that my participation is entirely voluntary and that my participation will not have any affect on my personal dealings with any companies within the Insurance Australia Group [IAG].

3. My participation in this Project will be from the commencement date to the end date specified on this form, or to the end of this Project. I can elect to withdraw from this Project (or I may become ineligible to participate in this Project), at any time (refer point 8 for more information).

4. I understand that this Project is may be ongoing, unless I am otherwise notified. In the event that this Project exceeds the five year maximum period of consent, this Project will be required to obtain a new consent form signed by me.

5. I understand that my details on this consent form will be provided to IAG.

6. I agree to Medicare Australia releasing the specified Medicare claims information about me to the Australian National University, and understand that this specified information will be collected, stored and analysed only for the purposes of this Project.

7. I understand that the specified Medicare claims information about me will not be published in a manner that could identify me as an individual, during or after the conclusion of this Project.

8. I understand that I can, at any time, withdraw my consent to participate in this Project (and to the further release of information about my episodes of hospitalisation). Should I wish to withdraw my consent, I can do so by:
   - telephoning the ACE Project Officer on 1300 557 479, or
   - writing to the ACE Project Officer, Accident Care Evaluation Study, PO Box 117, Deakin West ACT 2600.
   I also understand I may become ineligible should I no longer meet the criteria for the study.

9. In the event that I withdraw my consent, I understand that the effective date of this notification will be the date on which my withdrawal notice is received either by IAG, or this Project, and that information about me collected prior to this date will continue to be used and form part of this Project.

10. I understand that specified information about me collected for the purposes of this Project could be stored for a period of seven years after the conclusion of this Project, or until the completion of the evaluation of this Project, whichever date occurs last. At the end of this period, this information will be destroyed.

Authorised Person who can sign for the Participant

If you are a guardian or you have a power of attorney that extends to the right to make decisions about the person’s health care, you can sign the consent form on behalf of that person. The project requires confirmation of this authority, so a photocopy of authorising document must be attached to this form.

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• A letter from the prospective Participant’s usual medical practitioner advising that the individual concerned does not have the mental or physical capacity to consent on his or her own behalf and that participation in the Project is not contrary to the individual’s best interests; and,

• A statement from you (eg. the carer) attesting to the fact that you ordinarily make health decisions on behalf of the incapacitated individual.

Alternative forms of signature

Where the Participant or person who is consenting on behalf of the Participant is unable to sign due to illiteracy or physical impairment, the signature on the consent form may be in the form of the written name of the person who can give consent on behalf of the Participant, or a mark made by that person, if they are unable to sign. The mark on the consent form must be notated as his or her signature by a witness who is known to that person and be accompanied by information as to why they are unable to sign on their own behalf.
ACE Study Questionnaire

Were you involved in a motor vehicle crash?
Do you have a minor to moderate injury?

- Bending
- Whiplash
- Other similar injuries

You may be eligible to participate in the ACE study and help us discover how to improve services for people who are injured in the future.

Feedback is vital to help you and others.
PARTICIPANT DEMOGRAPHIC INFORMATION

Please use a BLACK PEN and tick the appropriate response.

Gender:  □ Male  □ Female

Age:  ___________ years

Marital Status:  □ Single
□ Married
□ Separated
□ Divorced
□ De facto
□ Widow(er)

Number of dependent children:  □ nil
□ 1
□ 2
□ 3
□ more than 3

Level of Education:  □ Primary
□ Secondary
□ TAFE/College
□ Tertiary
□ Other

Occupation:

Occupation Groups – Major Groups:  □ Managers and Administrators
□ Professionals
□ Associate Professionals
□ Tradespersons and Related Workers
□ Advanced Clerical and Service Workers
□ Intermediate clerical, sales and service
□ Intermediate production and transport
□ Elementary clerical, sales and service workers
□ Labourer and related workers
Work Status:
- In paid full time work
- In paid part time work  Number of hours/week __________
- Completely retired/pensioner
- Partially retired
- Performing unpaid work
- Student
- Home duties
- Disabled or sick
- Unemployed

Income:
- $2000 or more a week ($104,000 or more a year)
- $1600 - $1999 per week ($83,200 - $103,999 per year)
- $1300 - $1599 per week ($67,600 - $83,199 per year)
- $1000 - $1299 per week ($52,000 - $67,599 per year)
- $800 - $999 per week ($41,600 - $51,999 per year)
- $600 - $799 per week ($31,200 - $41,599 per year)
- $400 - $599 per week ($20,800 - $31,199 per year)
- $250 - $399 per week ($13,000 - $20,799 per year)
- $150 - $249 per week ($7,600 - $12,999 per year)
- $1 - $149 per week ($1 - $7,999 per year)

Country of Birth: ______________________

Language other than English spoken at home: ______________________

Home situation:
- Lives alone
- Live with spouse
- Lives with children/family
- Lives with parents
- Lives with flatmate/share accommodation
- Other ______________________

Post Code: [] [] [] []
CRASH DATA

Date of accident: __/__/20__
Time of accident: ___:___ a.m/p.m
Number of vehicles involved in the crash: __________

Direction of impact:
- □ Rear
- □ Head on
- □ Right hand side
- □ Left hand side

Wearing a seatbelt: □ Yes □ No

Speed of impact: __________ km/hour

Position in Vehicle:
- □ Driver
- □ Front Passenger
- □ Rear LHS Passenger
- □ Rear RHS Passenger
- □ Rear Middle Passenger
- □ Other

Did the accident occur on the way to/from work?:
- □ Yes □ No

Did the accident occur during work?:
- □ Yes □ No

Is this a potential Third Party Claim?:
- □ Yes □ No

Injury Severity Score:

Total: __________________________
**SF36 HEALTH SURVEY**

**INSTRUCTIONS:** This set of questions asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Answer every question by marking the answer as indicated. If you are unsure about how to answer a question please give the best answer you can.

1. **In general, would you say your health is:**

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
</tbody>
</table>

2. **Compared to one week ago, how would you rate your health in general now?**

<table>
<thead>
<tr>
<th>Much better now than one week ago</th>
<th>Somewhat better now than one week ago</th>
<th>About the same as one week ago</th>
<th>Somewhat worse now than one week ago</th>
<th>Much worse now than one week ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
</tbody>
</table>

3. **The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?**

   | | Yes, limited a lot | Yes, limited a little | Not limited at all |
   | | ▼ | ▼ | ▼ |

   - **a** VIGOROUS ACTIVITIES, such as running, lifting heavy objects, participating in strenuous sports
   - **b** MODERATE ACTIVITIES, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf
   - **c** Lifting or carrying groceries
   - **d** Climbing several flights of stairs
   - **e** Climbing one flight of stairs
   - **f** Bending, kneeling, or stooping
   - **g** Walking more than a kilometre
   - **h** Walking several hundred metres
   - **i** Walking one block
   - **j** Bathing or dressing yourself
4. During the *past week*, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

<table>
<thead>
<tr>
<th></th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>a: Cut down on the amount of time you spent at work or other activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b: Accomplished less than you would like</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c: Were limited in the kind of work or other activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d: Had difficulty performing the work or other activities (for example, it took extra effort)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

5. During the *past week*, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (e.g. feeling depressed or anxious)?

<table>
<thead>
<tr>
<th></th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>a: Cut down on the amount of time you spent at work or other activities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b: Accomplished less than you would like</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c: Did work or other activities less carefully than usual</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

6. During the *past week*, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

7. How much *bodily* pain have you had during the *past week*?

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Very Mild</th>
<th>Mild</th>
<th>Severe</th>
<th>Very Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

8. During the *past week* how much did *pain* interfere with your normal work (including both work outside the home and housework)?

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A little bit</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
9. These questions are about how you feel and how things have been with you during the past week. Please circle the answer that is closest to the way you have been feeling for each question.

<table>
<thead>
<tr>
<th></th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Old you feel fell of life?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>Have you been very nervous?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c</td>
<td>Have you felt so down in the dumps that nothing could cheer you up?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d</td>
<td>Have you felt calm and peaceful?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e</td>
<td>Did you have a lot of energy?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f</td>
<td>Have you felt downhearted and depressed?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g</td>
<td>Did you feel worn out?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h</td>
<td>Have you been happy?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i</td>
<td>Did you feel tired?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</tbody>
</table>

10. During the past week, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives etc.)?

<table>
<thead>
<tr>
<th></th>
<th>All of the time</th>
<th>Most of the time</th>
<th>Some of the time</th>
<th>A little of the time</th>
<th>None of the time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

11. How TRUE or FALSE is each of the following statements for you?

<table>
<thead>
<tr>
<th></th>
<th>Definitely True</th>
<th>Mostly True</th>
<th>Don't Know</th>
<th>Mostly False</th>
<th>Definitely False</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>I seem to get sick a little easier than other people</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>I am as healthy as anybody I know</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c</td>
<td>I expect my health to get worse</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d</td>
<td>My health is excellent</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</tbody>
</table>
## PART 2

Clinicians are aware that emotions play an important part in most illnesses. If your clinician knows about these feelings he or she will be able to help you more.

This questionnaire is designed to help your clinician to know how you feel. Read each item below and **underline the reply** which comes closest to how you have been feeling in the past week. Ignore the numbers printed at the edge of the questionnaire.

Don’t take too long over your replies, your immediate reaction to each item will probably be more accurate than a long, thought-out response.

### 1. I feel tense or 'wound up':
- most of the time
- a lot of the time
- from time to time, occasionally
- not at all

### 2. I still enjoy the things I used to enjoy:
- definitely as much
- not quite so much
- only a little
- not at all

### 3. I get a sort of frightened feeling like something awful is about to happen:
- very definitely and quite badly
- yes, but not too badly
- a little, but it doesn’t worry me
- not at all

### 4. I can laugh and see the funny side of things:
- as much as I always could
- not quite so much now
- definitely not so much now
- not at all

### 5. Worrying thoughts go through my mind:
- a great deal of the time
- a lot of the time
- not too often
- very little

### 6. I feel cheerful:
- never
- not often
- sometimes
- most of the time

### 7. I can sit at ease and feel relaxed:
- definitely
- usually
- not often
- not at all
8. I feel as if I am slowed down:
   nearly all of the time
   very often
   sometimes
   not at all

9. I get a sort of frightened feeling like 'butterflies in the stomach':
   not at all
   occasionally
   quite often
   very often

10. I have lost interest in my appearance:
    definitely
    I don't take as much care as I should
    I may not take quite as much care
    I take just a much care as ever

11. I feel restless as if I have to be on the move:
    very much indeed
    quite a lot
    not very much
    not at all

12. I look forward with enjoyment to things:
    as much as I ever did
    rather less than I used to
    definitely less than I used to
    hardly at all

13. I get sudden feelings of panic:
    very often indeed
    quite often
    not very often
    not at all

14. I can enjoy a good book, radio or TV programme:
    often
    sometimes
    not often
    very seldom
PART 3

In order to properly assess your condition, we must understand how much your injury has affected your ability to manage everyday activities. For each question, please place an [x] in the box that most closely describes your condition right now. Please circle the response (number) which most closely describes your condition right now.

1. Pain intensity

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>Mild pain</td>
<td>Moderate pain</td>
<td>Severe pain</td>
<td>Worst possible pain</td>
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</table>

2. Sleeping

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect sleep</td>
<td>Mildly disturbed sleep</td>
<td>Moderately disturbed sleep</td>
<td>Greatly disturbed sleep</td>
<td>Totally disturbed sleep</td>
</tr>
</tbody>
</table>

3. Personal care (washing, dressing etc.)

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain: no restrictions</td>
<td>Mild pain: need to go slowly</td>
<td>Moderate pain: need some assistance</td>
<td>Severe pain: need 100% assistance</td>
<td></td>
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</tbody>
</table>

4. Travel (driving, etc.)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain on long trips</td>
<td>Mild pain on long trips</td>
<td>Moderate pain on long trips</td>
<td>Moderate pain on short trips</td>
<td>Severe pain on short trips</td>
</tr>
</tbody>
</table>

5. Work

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can do usual work</td>
<td>Can do usual work: no extra work</td>
<td>Can do 50% of usual work</td>
<td>Can do 25% of usual work</td>
<td>Cannot work</td>
</tr>
</tbody>
</table>

6. Recreation

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can do all activities</td>
<td>Can do most activities</td>
<td>Can do some activities</td>
<td>Can do a few activities</td>
<td>Cannot do any activities</td>
</tr>
</tbody>
</table>

7. Frequency of pain

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>Occasional pain: 25% of the day</td>
<td>Intermittent pain: 50% of the day</td>
<td>Frequent pain: 75% of the day</td>
<td>Constant pain: 100% of the day</td>
</tr>
</tbody>
</table>
PRIMARAY SITE OF YOUR INJURY?

- Head
- Neck
- Shoulder
- Back
- Chest
- Abdomen
- Upper Limb
- Lower Limb
- Foot/Ankle
- Other:________

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# Appendix C Data tables

## Appendix Table C 1. Characteristics of people with mild to moderate musculoskeletal injuries sustained in road traffic crashes by fault status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Group n=193</th>
<th>At Fault n=55</th>
<th>Not at Fault n=136</th>
<th>mean difference (SE)</th>
<th>95% CI for mean difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>37.2 (14.0)</td>
<td>34.7 (14.26)</td>
<td>38.5 (13.77)</td>
<td>-3.8 (2.22)</td>
<td>-8.2 to 0.6</td>
<td>0.090</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>34 (24 - 47)</td>
<td>30 (24 - 43)</td>
<td>38 (27 - 48)</td>
<td></td>
<td></td>
<td>0.063</td>
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<tr>
<td>range</td>
<td>18 - 69</td>
<td>19 - 69</td>
<td>18 - 69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>116 (60.1)</td>
<td>25 (45.5)</td>
<td>89 (65.4)</td>
<td></td>
<td></td>
<td>0.011</td>
</tr>
<tr>
<td>Male (%)</td>
<td>77 (39.9)</td>
<td>30 (54.5)</td>
<td>47 (34.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single (%)</td>
<td>69 (35.1)</td>
<td>20 (36.4)</td>
<td>47 (34.6)</td>
<td></td>
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<td>0.337</td>
</tr>
<tr>
<td>Married / Defacto (%)</td>
<td>99 (51.8)</td>
<td>25 (45.5)</td>
<td>74 (54.4)</td>
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<tr>
<td>Separated / Divorced / Widow (%)</td>
<td>25 (13.1)</td>
<td>10 (18.2)</td>
<td>15 (11.0)</td>
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<td></td>
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<tr>
<td>No. of dependents</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nil (%)</td>
<td>122 (63.2)</td>
<td>38 (69.1)</td>
<td>82 (60.3)</td>
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<td></td>
<td>0.479</td>
</tr>
<tr>
<td>1 (%)</td>
<td>27 (14.0)</td>
<td>7 (12.7)</td>
<td>20 (14.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (%)</td>
<td>27 (14.0)</td>
<td>8 (14.5)</td>
<td>19 (14.0)</td>
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<td></td>
</tr>
<tr>
<td>3 (%)</td>
<td>13 (6.7)</td>
<td>1 (1.8)</td>
<td>12 (8.8)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>more than 3 (%)</td>
<td>4 (2.1)</td>
<td>1 (1.8)</td>
<td>3 (2.2)</td>
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<tr>
<td>Socioeconomic factors</td>
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<tr>
<td>Level of Education</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Primary (%)</td>
<td>4 (2.1)</td>
<td>0 (0.0)</td>
<td>4 (2.9)</td>
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</tr>
<tr>
<td>Secondary (%)</td>
<td>59 (30.6)</td>
<td>14 (25.5)</td>
<td>44 (32.4)</td>
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</tr>
<tr>
<td>College/TAFE (%)</td>
<td>51 (26.4)</td>
<td>18 (32.7)</td>
<td>33 (24.3)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Whole Group n=193</td>
<td>At Fault n=55</td>
<td>Not at Fault n=136</td>
<td>mean difference (SE)</td>
<td>95% CI for mean difference</td>
<td>p value</td>
</tr>
<tr>
<td>--------------------------------</td>
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<td>---------------</td>
<td>--------------------</td>
<td>-----------------------</td>
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<tr>
<td>Tertiary (%)</td>
<td>79 (40.9)</td>
<td>23 (41.8)</td>
<td>25 (40.4)</td>
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<tr>
<td>Occupational Groups</td>
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<tr>
<td>Managers/Prof (%)</td>
<td>89 (46.1)</td>
<td>25 (54.5)</td>
<td>63 (46.3)</td>
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<td>Employment Status</td>
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<td>In paid full-time or part-time employment work (%)</td>
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<td>Income</td>
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<td>$0 - $31,199 (%)</td>
<td>54 (28.0)</td>
<td>19 (34.5)</td>
<td>34 (25.0)</td>
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<td>$31,200 - $67,599 (%)</td>
<td>75 (38.9)</td>
<td>21 (38.2)</td>
<td>53 (39.0)</td>
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<td>$67,600 - $103,999 (%)</td>
<td>27 (14.0)</td>
<td>5 (9.1)</td>
<td>22 (16.2)</td>
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<td>&gt;$104,000 (%)</td>
<td>19 (9.8)</td>
<td>5 (9.1)</td>
<td>14 (10.3)</td>
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<tr>
<td>Declined to answer (%)</td>
<td>18 (9.3)</td>
<td>5 (9.1)</td>
<td>13 (9.6)</td>
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<td>Living arrangements</td>
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<tr>
<td>Lives alone (%)</td>
<td>19 (9.8)</td>
<td>5 (9.1)</td>
<td>14 (10.3)</td>
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<td>0.130</td>
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<tr>
<td>Lives with spouse / family (%)</td>
<td>152 (78.8)</td>
<td>40 (72.7)</td>
<td>111 (81.6)</td>
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<td></td>
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<tr>
<td>Lives with flatmate (%)</td>
<td>22 (11.4)</td>
<td>10 (18.2)</td>
<td>11 (8.1)</td>
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<td>Language other than English spoken at home</td>
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<td>Yes (%)</td>
<td>26 (13.5)</td>
<td>2 (3.6)</td>
<td>24 (17.6)</td>
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<tr>
<td>Variable</td>
<td>Whole Group n=193</td>
<td>At Fault n=55</td>
<td>Not at Fault n=136</td>
<td>mean difference (SE)</td>
<td>95% CI for mean difference</td>
<td>p value</td>
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<td><strong>Crash factors</strong></td>
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</tr>
<tr>
<td>Number of vehicles</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Single vehicle (%)</td>
<td>42 (21.8)</td>
<td>30 (54.5)</td>
<td>12 (8.8)</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2 or more vehicle (%)</td>
<td>151 (78.2)</td>
<td>25 (45.5)</td>
<td>124 (91.2)</td>
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<td>Driver status</td>
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<tr>
<td>Driver (%)</td>
<td>132 (68.4)</td>
<td>37 (67.3)</td>
<td>93 (68.4)</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Passenger/Pillion (%)</td>
<td>30 (15.5)</td>
<td>0 (0.0)</td>
<td>30 (22.1)</td>
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<tr>
<td>Motorbike rider (%)</td>
<td>31 (16.1)</td>
<td>18 (32.7)</td>
<td>13 (9.6)</td>
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<tr>
<td>Speed of Impact (kph)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>mean (SD)</td>
<td>57.2 (24.11)</td>
<td>60.9 (23.62)</td>
<td>55.6 (24.43)</td>
<td>5.3 (4.0)</td>
<td>-2.5 to 13.2</td>
<td>0.180</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>60 (40 - 75)</td>
<td>60 (45 - 80)</td>
<td>60 (40 - 70)</td>
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<td>0.153</td>
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<td>0 - 125</td>
<td>5 - 125</td>
<td>0 - 120</td>
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<tr>
<td><strong>Injury factors</strong></td>
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</tr>
<tr>
<td>Number of Injuries</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>mean (SD)</td>
<td>3.2 (1.56)</td>
<td>3.1 (1.36)</td>
<td>3.3 (1.63)</td>
<td>-0.3 (.25)</td>
<td>-0.8 to -0.2</td>
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<tr>
<td>median (IQR)</td>
<td>3 (2 - 4)</td>
<td>3 (2 - 4)</td>
<td>3 (2 - 4)</td>
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<tr>
<td>Injury Severity Score</td>
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<tr>
<td>minor (ISS 1-3)</td>
<td>162 (83.9)</td>
<td>43 (78.2)</td>
<td>117 (86)</td>
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<tr>
<td>moderate (ISS &gt;4)</td>
<td>31 (16.1)</td>
<td>12 (21.8)</td>
<td>19 (14)</td>
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<td>MAIS (Maximum AIS)</td>
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<tr>
<td>minor (%)</td>
<td>168 (87.0)</td>
<td>45 (83.3)</td>
<td>120 (88.2)</td>
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<td>0.266*</td>
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<td>moderate (%)</td>
<td>22 (11.5)</td>
<td>7 (13.0)</td>
<td>15 (11.0)</td>
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<td>serious (%)</td>
<td>3 (1.6)</td>
<td>2 (3.3)</td>
<td>1 (0.7)</td>
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<td></td>
<td>0.152*</td>
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<td>Primary site of injury</td>
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*348*
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<th>Variable</th>
<th>Whole Group n=193</th>
<th>At Fault n=55</th>
<th>Not at Fault n=136</th>
<th>mean difference (SE)</th>
<th>95% CI for mean difference</th>
<th>p value</th>
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<tr>
<td>Neck %</td>
<td>88 (45.6)</td>
<td>20 (36.4)</td>
<td>67 (49.3)</td>
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<td>Chest %</td>
<td>32 (16.6)</td>
<td>11 (20.0)</td>
<td>20 (14.7)</td>
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</tr>
<tr>
<td>Back (thoracic or lumbar spine) %</td>
<td>29 (15.0)</td>
<td>7 (12.7)</td>
<td>22 (16.2)</td>
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<tr>
<td>Upper/lower limb %</td>
<td>26 (13.5)</td>
<td>9 (16.4)</td>
<td>17 (12.5)</td>
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<td>Shoulder %</td>
<td>14 (7.3)</td>
<td>7 (12.7)</td>
<td>7 (5.1)</td>
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<td>Head %</td>
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<td>Abdo/Pelvis %</td>
<td>1 (0.5)</td>
<td>1 (1.8)</td>
<td>0 (0.0)</td>
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<tr>
<td>Neck as any injury</td>
<td>152 (78.8)</td>
<td>34 (61.8)</td>
<td>117 (86.0)</td>
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<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Neck injury (%)</td>
<td>152 (78.8)</td>
<td>34 (61.8)</td>
<td>117 (86.0)</td>
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<td></td>
<td>&lt;0.001</td>
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<td>Neck or back as any injury</td>
<td>162 (83.9)</td>
<td>38 (69.1)</td>
<td>123 (90.4)</td>
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<td></td>
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<tr>
<td>Neck or back injured (%)</td>
<td>162 (83.9)</td>
<td>38 (69.1)</td>
<td>123 (90.4)</td>
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<td></td>
<td>&lt;0.001</td>
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</tbody>
</table>

**Compensation factors**

Fault status:
- At fault 55 (28.8)
- Not at fault 136 (71.2)

Days from crash to baseline data:
- mean (SD) 9.3 (5.45), 9.2 (5.35), 9.4 (5.51), -0.2 (0.87), -2.0 - 1.6, 0.867
- median (IQR) 8 (5 - 13), 8 (5 - 13), 8 (5 - 13), | 0.901 |
- range 1 - 25, 2 - 22, 1 - 25

---

*a* fault status could not be determined for 2 subjects

*b* Mann-Whitney U-test

*c* Fisher's Exact test
<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>PCS mean (SE)</th>
<th>PCS p</th>
<th>FRI mean (SE)</th>
<th>FRI p</th>
<th>Pain Intensity mean (SE)</th>
<th>Pain Intensity p</th>
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</thead>
<tbody>
<tr>
<td>Age a</td>
<td>n/a</td>
<td>B= -.01 (.046)</td>
<td>0.892</td>
<td>B=.11 (.108)</td>
<td>0.332</td>
<td>B=.01 (.004)</td>
<td>0.425</td>
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<tr>
<td>Gender</td>
<td>Male</td>
<td>36.3 (1.03)</td>
<td>0.557</td>
<td>53.5 (2.38)</td>
<td>0.284</td>
<td>1.8 (.09)</td>
<td>0.022</td>
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<td></td>
<td>Female</td>
<td>35.5 (.85)</td>
<td>0.557</td>
<td>56.8 (1.94)</td>
<td>2.1</td>
<td>2.1 (.07)</td>
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<tr>
<td>LOTE</td>
<td>Yes</td>
<td>36.8 (1.77)</td>
<td>0.570</td>
<td>59.4 (4.10)</td>
<td>0.306</td>
<td>2.3 (.16)</td>
<td>0.015</td>
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<tr>
<td></td>
<td>No</td>
<td>35.7 (.70)</td>
<td>0.570</td>
<td>54.9 (1.62)</td>
<td>1.9</td>
<td>1.9 (.06)</td>
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<tr>
<td>ISS Group</td>
<td>Minor (ISS 1-3)</td>
<td>37.0 (.68)</td>
<td>&lt;0.001</td>
<td>55.5 (1.61)</td>
<td>0.002</td>
<td>1.9 (.06)</td>
<td>0.280</td>
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<tr>
<td></td>
<td>Moderate (ISS ≥4)</td>
<td>27.8 (1.54)</td>
<td>&lt;0.001</td>
<td>66.0 (3.68)</td>
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<td>2.1 (1.5)</td>
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</tr>
<tr>
<td>MAIS</td>
<td>Minor</td>
<td>37.0 (.66)</td>
<td>&lt;0.001</td>
<td>53.8 (1.58)</td>
<td>0.009</td>
<td>1.9 (.06)</td>
<td>0.594</td>
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<tr>
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<td>Moderate</td>
<td>29.1 (1.82)</td>
<td>&lt;0.001</td>
<td>67.0 (4.37)</td>
<td>2.1</td>
<td>2.1 (.17)</td>
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</tr>
<tr>
<td></td>
<td>Serious</td>
<td>29.3 (4.94)</td>
<td>&lt;0.001</td>
<td>68.3 (11.33)</td>
<td>2.3</td>
<td>2.3 (.47)</td>
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<tr>
<td># injured sites a</td>
<td>n/a</td>
<td>B= -1.58 (.400)</td>
<td>&lt;0.001</td>
<td>B=3.61 (.931)</td>
<td>&lt;0.001</td>
<td>B=.14 (.036)</td>
<td>&lt;0.001</td>
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<tr>
<td>Neck or Back Injured</td>
<td>Yes</td>
<td>36.0 (.77)</td>
<td>0.801</td>
<td>56.3 (1.65)</td>
<td>0.716</td>
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<tr>
<td></td>
<td>No</td>
<td>35.5 (1.62)</td>
<td>&lt;0.001</td>
<td>56.8 (3.77)</td>
<td>1.9</td>
<td>1.9 (1.55)</td>
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<td>Fault status</td>
<td>At fault</td>
<td>34.8 (1.21)</td>
<td>0.339</td>
<td>52.6 (2.83)</td>
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<td>1.8 (.11)</td>
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<td>Not at fault</td>
<td>36.2 (.77)</td>
<td>0.339</td>
<td>56.8 (1.80)</td>
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<td>2.0 (.07)</td>
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<td>FRI</td>
<td></td>
<td>Pain Intensity</td>
<td></td>
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<td>----------------</td>
<td>------------</td>
<td>--------------</td>
<td>---------</td>
<td>--------------</td>
<td>---------</td>
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<td>---------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mean (SE)</td>
<td>p</td>
<td>mean (SE)</td>
<td>p</td>
<td>mean (SE)</td>
<td>p</td>
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<td>Study group</td>
<td>Control</td>
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<td>0.814</td>
<td>2.0 (0.08)</td>
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<td>Intervention</td>
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<td>55.9 (2.12)</td>
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<td>2.0 (0.08)</td>
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</table>

PCS mean (SD) for group: 35.9 (9.03)
FRI mean (SD) for group: 55.5 (21.04)
Pain intensity mean (SD) for group: 2.0 (0.81)

*a beta coefficient and SE reported for continuous variables*
### Appendix Table C 3. Unadjusted association between explanatory variables and psychological health measures post-crash

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>MCS</th>
<th></th>
<th>HADS-anxiety</th>
<th></th>
<th>HADS-depression</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SE)</td>
<td>p</td>
<td>Mean (SE)</td>
<td>p</td>
<td>Mean (SE)</td>
<td>p</td>
</tr>
<tr>
<td>Age</td>
<td>n/a</td>
<td>B = -.04 (.071)</td>
<td>.619</td>
<td>B = -.01 (.023)</td>
<td>.824</td>
<td>B = .01 (.021)</td>
<td>.873</td>
</tr>
<tr>
<td></td>
<td>Male</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>37.2 (1.52)</td>
<td>&lt;0.001</td>
<td>7.6 (.41)</td>
<td>&lt;0.001</td>
<td>5.3 (.46)</td>
<td>0.003</td>
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<td>Female</td>
<td>29.8 (1.23)</td>
<td>10.1 (.50)</td>
<td>7.0 (.37)</td>
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<tr>
<td>LOTE</td>
<td>Yes</td>
<td>23.9 (2.62)</td>
<td>&lt;0.001</td>
<td>12.6 (.85)</td>
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<td>8.4 (.79)</td>
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<td>No</td>
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<td>8.6 (.34)</td>
<td>6.0 (.31)</td>
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<td>ISS Group</td>
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<td>32.2 (1.08)</td>
<td>.225</td>
<td>9.2 (.36)</td>
<td>.625</td>
<td>6.2 (.32)</td>
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<td>Moderate (ISS 4+)</td>
<td>35.5 (2.47)</td>
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<td>8.8 (.82)</td>
<td>6.9 (.74)</td>
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<tr>
<td>MAIS</td>
<td>Minor</td>
<td>32.0 (1.04)</td>
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<td>9.3 (.35)</td>
<td>6.2 (.32)</td>
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<td>36.2 (2.89)</td>
<td>8.4 (1.0)</td>
<td>6.9 (.87)</td>
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<tr>
<td></td>
<td>Serious</td>
<td>50.0 (7.82)</td>
<td>6.7 (2.61)</td>
<td>6.0 (2.27)</td>
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<tr>
<td># injured sites</td>
<td>n/a</td>
<td>B = -1.29 (.628)</td>
<td>.041</td>
<td>.224</td>
<td>.002</td>
<td>B = .50 (.185)</td>
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<td>Neck or Back</td>
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<td>Injured</td>
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<td>9.6 (.35)</td>
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<td>6.3 (.32)</td>
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<td>5.6 (.56)</td>
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<td>HADS-depression</td>
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<tr>
<td>Study</td>
<td>Control</td>
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<td>0.932</td>
<td>6.2 (0.42)</td>
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<td>Intervention</td>
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<td>9.1 (.46)</td>
<td>6.4 (0.41)</td>
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<tr>
<td>status</td>
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<td>9.5 (.39)</td>
<td>6.6 (.35)</td>
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</table>

MCS mean (SD) for group: 32.7(9.03)
HADS-anxiety mean (SD) for group: 9.1 (4.55)
HADS-depression mean (SD) for group: 6.3 (4.11)

* beta coefficient (SE) reported for continuous variables
## Appendix Table C 4. Baseline characteristics of people with mild to moderate musculoskeletal injuries sustained in road traffic crashes by study group status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control n= 95</th>
<th>Intervention n=98</th>
<th>mean difference (SE)</th>
<th>95% CI</th>
<th>p</th>
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<td><strong>General demographics</strong></td>
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<tr>
<td>Age</td>
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</tr>
<tr>
<td>mean (SD)</td>
<td>36.7 (13.87)</td>
<td>37.7 (14.17)</td>
<td>-1.0 (2.02)</td>
<td>-5.0 to 3.0</td>
<td>0.625</td>
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<td>median (IQR)</td>
<td>33 (25-45)</td>
<td>36 (24-49)</td>
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<td>range</td>
<td>18 - 69</td>
<td>18 - 69</td>
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</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<tr>
<td>Female (%)</td>
<td>58 (61.1)</td>
<td>58 (59.2)</td>
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<td>Male (%)</td>
<td>37 (38.9)</td>
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<td>Marital Status</td>
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<td>Single (%)</td>
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<td>39 (39.8)</td>
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<td>Married/Defacto (%)</td>
<td>52 (54.7)</td>
<td>47 (48)</td>
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<td>Separated/Divorced (%)</td>
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<td>12 (12.2)</td>
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<td>No. of dependents</td>
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<td>1 (%)</td>
<td>13 (13.7)</td>
<td>14 (14.3)</td>
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<tr>
<td>2 (%)</td>
<td>11 (11.6)</td>
<td>16 (16.3)</td>
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<tr>
<td>3 or more (%)</td>
<td>11 (11.6)</td>
<td>6 (6.1)</td>
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<td><strong>Socioeconomic factors</strong></td>
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<td><strong>Mean (SE) 95% CI</strong></td>
<td><strong>p value</strong></td>
<td><strong>Mean (SE) 95% CI</strong></td>
<td><strong>p value</strong></td>
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<td>p value</td>
<td>FRI Mean (SE) 95% CI</td>
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12 month PCS mean (SE) for group (n=154): 48.8 (0.79)  
12 month FRI mean (SE) for group (n=157): 23.3 (1.74)  
12 month Pain intensity mean (SE) for group (n=157): 0.90 (0.08)  

* beta coefficient and SE reported for continuous variables.
### Appendix Table C 6. Unadjusted association between explanatory variables and 12 month psychological health measures

<table>
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<tr>
<th>Variable</th>
<th>Category</th>
<th>MCS Mean (SE)</th>
<th>p value</th>
<th>HADS-anxiety Mean (SE)</th>
<th>p value</th>
<th>HADS-depression Mean (SE)</th>
<th>p value</th>
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<td>Age <em>a</em></td>
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<td>B = -.11 (.071)</td>
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<td>B = -.01 (.026)</td>
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<td>5.7 (0.56)</td>
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<td>7.9 (0.47)</td>
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<td>Mean (SE)</td>
<td>p value</td>
<td>Mean (SE)</td>
<td>p value</td>
<td>Mean (SE)</td>
<td>p value</td>
</tr>
<tr>
<td># injuries *</td>
<td>n/a</td>
<td>B = -0.61 (0.69)</td>
<td>0.372</td>
<td>B = 0.02 (0.25)</td>
<td>0.929</td>
<td>B = 0.4 (0.22)</td>
<td>0.053</td>
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<td>Neck or Back Injured</td>
<td>Yes</td>
<td>43.7 (1.10)</td>
<td>0.403</td>
<td>7.1 (0.41)</td>
<td>0.696</td>
<td>4.5 (0.35)</td>
<td>0.801</td>
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<tr>
<td></td>
<td>No</td>
<td>46.0 (2.56)</td>
<td>6.7 (0.92)</td>
<td>4.7 (0.79)</td>
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<tr>
<td>Fault status</td>
<td>At fault</td>
<td>47.0 (1.94)</td>
<td>0.082</td>
<td>6.0 (0.71)</td>
<td>0.081</td>
<td>3.6 (0.62)</td>
<td>0.058</td>
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<tr>
<td></td>
<td>Not at fault</td>
<td>43.0 (1.07)</td>
<td>7.4 (0.43)</td>
<td>4.9 (0.37)</td>
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<tr>
<td>Compensation status</td>
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<td>3.6 (0.60)</td>
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<td>Compensable and claimed</td>
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<td>8.2 (0.61)</td>
<td>5.9 (0.52)</td>
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<td>Compensable and no claim</td>
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<td>6.6 (0.60)</td>
<td>3.9 (0.51)</td>
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<td>Control</td>
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<td>Intervention</td>
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<tr>
<td>Lawyer rep</td>
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<td>46.2 (1.15)</td>
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12 month MCS mean (SE) for group (n=154): 44.1 (1.02)
12 month HADS-a mean (SE) for group (n=157): 7.0 (0.37)
12 month HADS-d mean (SE) for group (n=157): 4.6 (0.32)

* beta coefficient and SE reported for continuous variable